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Cheap Lamps. THE progress which lamp making has made in some foreign countries is well illustrated by a circular just received from a large continental company showing that it offers lamps made for almost any sockets, in lots of several thousand, at 19 cents f. o. b. at a European seaport. This, with our duty of 45 per cent. and freight expenses added, brings the cost of the lamp in this city to about 30 cents. This is certainly very cheap and its effect will probably be to diminish the price of lamps here, provided patents do not interfere. Conceding the fact that our money has less purchasing power here than abroad, yet the difference in the price of lamps in the two countries, being over 100 per cent., is far greater than that of the purchasing power of money. Europeans can therefore enjoy cheaper electric lighting than we can, as far as the lamps are concerned, even after making due allowance for the difference in the value of the money. Some of the difference in the price of lamps is doubtless due to cheaper labor, but it is also likely that manufacturers abroad are satisfied with less profit.

The Discussions at the American Institute. WE regret to see from the discussions at the last meeting of the American Institute of Electrical Engineers that there is a tendency on the part of some members to become too personal in their remarks. It is to be regretted very much that the high standing of the Institute should be injured by permitting such remarks to be made, and, worse yet, that they should be allowed to get into print. The American Institute of Electrical Engineers is a society of engineers, and its meetings are not the place to vent any personal feelings, nor are they intended to give an opportunity to competing companies to ridicule each other. Free expression of thought ought, of course, to be allowed, but it should be stopped as soon as it ceases to be of value from an engineer's standpoint, and when it tends toward a purely personal character. A little innocent humor is quite refreshing if of a proper character, as the members had a good occasion to see last year, but it should not be allowed to be of a stinging or personal nature. The presiding officer would do well to stop this tendency by sharp ruling if necessary, for if once allowed to grow it will be much more difficult to put an end to it.

Evening Displays at the World's Fair. THOSE of our readers who, as intending exhibitors, or only, perhaps, as prospective visitors, take an interest in the World's Fair arrangements, will be pleased to receive the assurance contained in the letter of our Chicago correspondent, given on the next page, that it is not now, and, in fact, never has been, the intention of the authorities to close the exhibition during the evening hours of every day. This is, of course, as it should be, since closing the gates at the dusk of each day would mean the abandonment by all electrical exhibitors of their plans to produce displays, the effect of which would depend upon their electric lighting arrangements. Many firms are preparing their plans to make exhibits, not merely of unattractive machinery, but to add as much as possible to the beauty and prominence of their displays by whatever decorative effects may be obtained by the use of the electric light. It would, of course, be an unwise policy that would make such features as this impossible, and all friends of the enterprise will be glad to learn that rumors of the passage of rules providing for evening closing are not well founded. We think that those who have in charge the preparation of rules to govern the conduct of the Fair may safely be trusted to give every consideration to whatever promises to add to the success, financial or otherwise, of an undertaking which has been so admirably carried forward to its present condition of comparative completeness, so far as the preparation for the reception of exhibits and arrangements for their display are concerned.

The Effect of the Election on Electrical Industries. WHAT the effect of the recent election will be on the electrical industries of this country it is hardly safe to predict at this time. That it will in general affect the buyer favorably there is little doubt, nor is there any doubt that it will affect some of the domestic manufacturers unfavorably at first. Assuming, as we believe can safely be done, that the present tariff will merely be reduced, it will naturally affect only such goods as the foreigner can make more cheaply. For instance, many electrical sundries made here are already as cheap, if not cheaper, than those made abroad, and will, therefore, not be affected to any great extent. Articles made mostly by machinery, as many American goods are, will doubtless remain as they are, cheaper than those from abroad, but where much labor is required, as in the case of dynamos, they will probably at first be imported, to some extent at least, until American ingenuity has succeeded in devising cheaper methods of construction. Cheaper raw materials cannot fail to be of benefit to electrical manufacturers who use but do not make them. From the United States report on the recent Paris Exposition it appeared that the price of dynamos abroad was such that the transportation and duty, at that time, would bring their total cost to an American purchaser up to about the cost of American dynamos. This refers only to constant potential machines, as the arc or constant current machines are typical American goods, which are practically without competition from abroad, and, what is more, are being introduced on no small scale on the other side—a good illustration of the supremacy of ingenuity over cheap labor. The reduction in the tariff will therefore probably affect only a portion of the electrical industries, and in these it is hoped that it will have the beneficial result, always accompanying any competition, of cheapening goods, which in turn cannot fail to increase the quantities sold.

Railway Papers at the Institute. IN the discussion of the three railway papers at the last meeting of the American Institute of Electrical Engineers there seems to have been a general concurrence of opinion regarding certain propositions, if we may judge from the expressions of some prominent engineers and from the replies, or the absence of replies, to their remarks. In general, the series system of running electric railways appears to be old. It has been tried and consigned to the archives of the museum as impracticable. While it appears to have some points in its favor there seem to be objections inherent to the system which it is not likely that any invention of ingenious devices will ever overcome quite satisfactorily, at least not with so formidable a rival in the field as the present well developed multiple system. Whatever may be said against the cost of copper in a line it must not be forgotten that this part of the plant, involving no complicated machinery, suffers the least from depreciation and cost of maintenance and repairs, considering here only the difference in the cost between a heavy and a light line. It is often more profitable to make a larger investment, if that simplifies the plant and reduces maintenance, repairs and depreciations. Regarding Mr. Leonard's device, it appeared to be generally conceded that it was ingenious, but objections were taken against some of his figures and statements. Stress was laid on the fact that simplification, rather than complication, was desired in railway practice. While the present motors are inefficient at starting, the length of time it requires to start is relatively so small that this inefficiency becomes of less importance as compared with other features. As a road is about to be equipped with this system, it may be better, in justice to Mr. Leonard, to wait until he has had a chance to show what the system can do in practice, as that, after all, is the best test. Regarding the motor tests of Prof. Shepardson and Mr. Burch some criticisms and comparisons were made by Dr. Hutchinson, to which those readers who are interested are referred. Regarding the comparative value of the rheostat and the commutated field methods of regulating, he suggests to settle the discussion once for all by a comparative table which he submits and from which he concludes that in all cases the commutated field method gives a better efficiency than the other.

Utilizing Earth Currents. IT has often been found that a formidable enemy when properly harnessed may become as formidable a friend and can then be made quite useful. While this has been done in a number of cases, it does not follow that this can always be accomplished. In an article published in this issue the author makes the ingenious suggestion that the earth currents, which are such a nuisance to telegraphers, might possibly be put to some use. While this would be desirable it is hardly likely that it will ever amount to much except as a mere matter of interest, for a number of reasons. In the first place the more frequent weak currents are too feeble to be of much use except possibly in a number of very limited cases for telegraphic purposes, but even then they are too unreliable and variable, and the only saving would be in batteries, which after all is not a matter of great importance. The strong currents are by far too erratic to be of any use; besides, they seem to occur only every eleven years, and it would hardly be worth while to have any apparatus lie idle for ten years to be used only during a portion of every eleventh year. While the voltage of some of these earth currents appears to be quite high, reaching 600 to 700 volts, it must not be forgotten that this is only between two points separated by a considerable distance. In the number of cases cited there would not be more than about one to one and a half volts per mile, and it would not be practicable to build a line to utilize such a voltage for power or lighting purposes. Another thing is to be considered. This difference of potential in different parts of the earth is more of the nature of a charge in a condenser, which will no longer exist when the cause is removed and the two parts are connected by a wire. The only current that would be generated is during a charge and discharge. It is therefore not in the nature of a continuous source of electromotive force, as in the battery or a dynamo which is continually regenerated. Furthermore, a line wire does not, in that case, act as a return circuit for the earth, but the two are in multiple and the only current in the line would be its share when considered as a shunt to the earth. An electric storm, as at present understood, would treat the line wire as if it were merely a good conductor forming part of the earth; a bare wire, for instance, buried in the earth would probably show about the same current as if it were overhead. While the suggestion of the author is an ingenious one we think it is like others of a similar nature, as for instance the utilizing of the tides, on which inventors have spent more time than the possible results would warrant, and we would not wish, therefore, to encourage inventors to give much thought to a possible commercial use of earth currents.

Flashing Election Returns.

THE electric search light has become very popular during the last year for flashing signals to distant points.

The New York *Herald* took advantage of this to send out election returns last week for the benefit of those who were unable to take advantage of the various newspaper bulletins in the different parts of the city. It secured the use of the powerful search light on the tower of the Madison Square Garden, and by a prearranged system of signals it informed the residents of the outskirts of New York City and the neighboring cities and towns of the result of the election. It was previously announced that if the returns indicated that Harrison had carried New York State the light would be thrown in the direction of Harlem, while if the State went for Cleveland it would be flashed in the opposite direction, toward the Battery; if it appeared that Harrison had carried the country the beam of light would be thrown over toward New Jersey, but if the election of Cleveland was assured it would be

Flashing Election Returns.

cast toward Brooklyn. This method of indicating the returns proved very satisfactory, and the rays of light could be seen for many miles.

The Electric Arc.

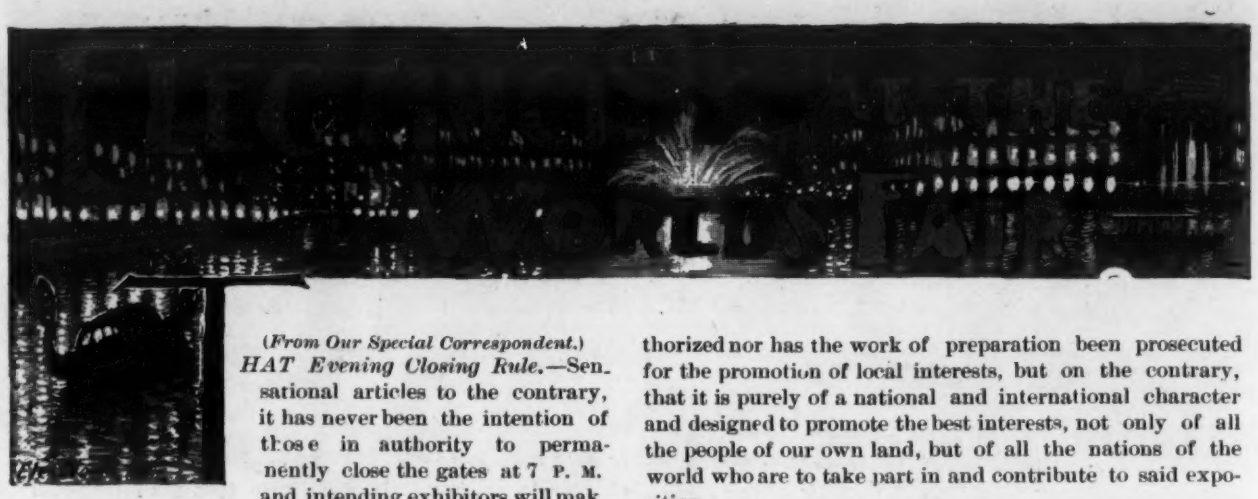
Mr. Robert S. Dobbie delivered an interesting lecture before the New York Electrical Society on Thursday, Nov. 10, 1892, at Columbia College. The lecture was illustrated by a large number of lantern slides, showing many phenomena of the electric arc and the various types of lamp mechanisms. The following is a brief abstract of Mr. Dobbie's remarks:

As long ago as 1810 Sir Humphry Davy first showed what is called the electric arc, but it is only within the last 10 or 15 years that practical use has been made of this splendid discovery. He connected the poles of a large primary battery to two pieces of charcoal fastened to suitable holders, and these were first pushed together to establish a current and then gradually drawn apart, thus forming an arc.

Prof. S. P. Thompson has explored the region between the carbons with a view of determining the location and distribution of the E. M. F. He found that what is called the crater of the positive carbon varies in size and shape, the size being determined by the current and the shape by the E. M. F., other things being equal. Broadly speaking, the greater the current the larger the crater; if the E. M. F. is varied we find with a small difference of potential a deep crater, which becomes more shallow as the potential difference increases, and if carried beyond a certain point no crater is formed, and the end of the carbon assumes a rounded appearance.

Sir Humphry Davy dipped his pieces of carbon while red hot into the mercury in order to increase their conductivity, this seems to be the earliest record of improving carbon for use in the electric arc. But as early as 1846 efforts were made, especially in France, to improve carbon electrodes for commercial use. At the present time, however, we have a cheap and pure form of carbon that does not need purification by expensive methods. The various operations of forming a carbon all have a bearing on the finished product. The hardness of the carbon is not the only property which renders it suitable for use in arc lighting, as some of the softest carbons last long and burn steadily. Hard carbons, if of amorphous structure, are, however, the best of all; carbons of a crystalline structure do not appear to work well.

To produce a steady arc light suitable for commercial purposes, many things must be taken into consideration, such as the generator or source of supply, the carbon, the quality of which strongly influences the character of the arc, and the mechanism regulating the distance between the electrodes. A great amount of work has been expended upon regulators and there are at least a dozen different principles upon which arc lamps can be made which if properly constructed will operate perfectly. The principles that govern a successful arc lamp are simplicity, especially mechanical simplicity, and the proper proportion of the parts of the magnetic circuits and electrical resistances.



(*From Our Special Correspondent.*)

HAT Evening Closing Rule.—Sensational articles to the contrary, it has never been the intention of those in authority to permanently close the gates at 7 P. M. and intending exhibitors will mak a sad mistake if they allow sensational articles to interfere with any elaborate preparations for a creditable exhibit. When the rules were under consideration the question of whether it would prove profitable to remain open every night in the week, in view of the heavy additional expense that will be incurred after 6 P. M., came up, and it was then decided to add a saving clause that would enable the gates to be closed should it be found that on one or two evenings in the week, as for instance, on Monday and Friday, the attendance should prove so small as not to warrant the extra expense involved. Exhibitors have only to remember that an average of three days in each week have already been planned for gala days, when the gates will remain open till 10 P. M. or 11 P. M., thus on only three nights in each week could the gates be closed if desired, and of these remaining three nights probably an average of one or two will be added to the number already taken by State, city, fraternal or social organizations and advertised as the day set apart for their enjoyment.

D. H. Burnham, Chief of the Construction Department of the World's Fair.

Sunday Closing.—It is also well to bear in mind that whatever good influence the directory can bring to bear will be exerted toward having Congress rescind its action and throw open the gates on Sunday to enable the visitors to inspect the exterior of the buildings, the grounds and the thousand and one features that are not included in a "moving exhibit." That the directors intend that the heavy machinery shall not be in motion and that as few employés as possible shall be on duty is clearly outlined in the resolutions, drawn by Edwin Walker, and adopted on Friday, with only four dissenting votes, Keith, Camp, Pike and Welling.

These are the resolutions adopted by the board on the Sunday question:

Whereas, By an act of Congress approved Aug. 5, 1892, "five millions of Columbian half dollars" were appropriated to "provide for celebrating the 400th naniversary of the discovery of America by Christopher Columbus by holding an international exposition of arts, industries, manufactures and products of the soil, mine and sea in the city of Chicago, in the State of Illinois," on the "condition that the said Exposition shall not be open to the public on the first day of the week, commonly called Sunday;" and

A Typical Piece of Decoration on the Electricity Building.

Whereas, The board of directors of the World's Columbian Exposition has accepted such appropriation, subject to the conditions thereto attached, and intends to abide by the will of Congress as expressed in law; and

Whereas, Said board of directors has not adopted any rules or taken any action affecting the control or management of said Exposition on the first day of the week, commonly called Sunday; and

Whereas, While the board of directors has formally accepted said appropriation, subject to such restrictions so imposed by the act of Congress, still it is not only proper but the duty of the board to give formal expression of its judgment relative to such restrictions and to the matter of control of said exposition on Sunday, and the interest of the public therein.

Now, therefore, the board of directors express their judgment relative thereto:

We recognize the fact that the Exposition was not authorized nor has the work of preparation been prosecuted for the promotion of local interests, but on the contrary, that it is purely of a national and international character and designed to promote the best interests, not only of all the people of our own land, but of all the nations of the world who are to take part in and contribute to said exposition.

We further recognize the fact that, as directors, we are the active trustees of our stockholders and have also accepted a trust of the highest and broadest character, in which all the people are directly interested.

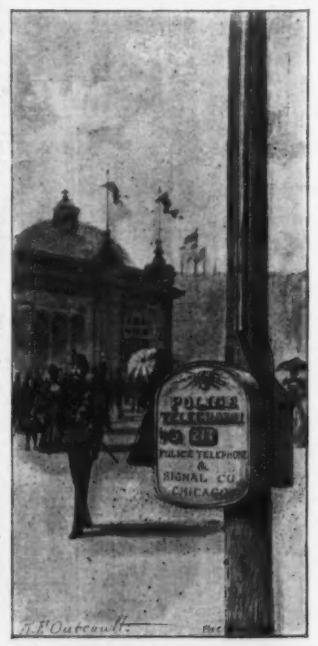
Section of Panel in the Transportation Building.

We believe that said Exposition should be so conducted, managed and controlled, as will best promote the social, moral and educational interests of all the people.

We believe that within said Exposition there will be representatives of all that is good and useful, beautiful and artistic, and that the same will be object lessons in science, art, education and history, such as are not likely to be again offered to the present generation.

We believe that while the period of the Exposition is limited by law the people should not be prohibited from visiting the same on Sundays during the life of said Exposition.

It is our judgment that the exposition should be open on Sunday under such rules and regulations as will prohibit the use of machinery, unnecessary manual labor, and all merchandizing, and at the same time give opportunity for the study of the highest standard of artistic and mechanical science; that the art gallery, the horticultural building, and all other buildings in which exhibits of mechanical art are exhibited should be thrown open to the public on each and every day during the entire time of the Exposition, also that each employé should be given one day of each week for rest, study or recreation.



A Police Telegraph Box.

We believe that the study on Sunday of such exhibits of science and art, and of the skill and genius of the artisan, will not only be of inestimable educational advantage, but that the thoughts of the visitors will be lifted above these creative agencies to the Great Creator of all things useful and beautiful.

We further believe that on each Sunday afternoon there should be held within the Exposition grounds religious services, so arranged that each of our religious organizations may have a Sunday set apart for its particular service, under the control and direction of its most prominent clergymen, with songs of praise and anthems, in the best form of sacred music. Our original plans embraced a large hall capable of seating 7,000 people for this use on Sunday.

We believe that the closing of the Exposition on Sundays will deprive millions of our people of these advantages.

We believe that the closing of the Exposition on Sunday would in many instances be in violation of the spirit of hospitality which has characterized our invitation to foreign nations.

We further believe that the citizens of the several States should have the privilege of visiting on Sunday the tem-

porary buildings or homes, within the Exposition grounds, erected by the respective States, for the free interchange of thought and social amenities. Therefore be it

Resolved, That the foregoing preambles and recitals be and are adopted by the board of directors as expressing its best judgment upon the matter of Sunday closing during the Exposition.

Space Granted for Foreign Exhibits.—The official notifications of space granted sent out up to the present include in the Manufactures Building as follows: Siam, 1,096 square feet; Paraguay, 498; Brazil, 5,702; Hayti, 1,189; Mexico, 5,492; New South Wales, 5,266; Ceylon, 931. To the British colonies, so far as at present allotted, as follows: Barbadoes, 423 square feet; Bahamas, 423; British Guiana, 466; British Honduras, 423. India entire is allotted 3,193 square feet: Jamaica, 4,855; Leeward Islands, 523; Trinidad, 466; Windward Islands, 523.

The illustrations on this and the opposite page show some of the features of the buildings now so near completion. The large illustration shows admirably the details of the architecture of the Electricity Building, as the view presented is that obtained as one looks north along the side of that structure from the point where the artist has placed a couple of interested spectators. The large structure seen across the lagoon on the right is the Liberal Arts Building, in which the dedicatory exercises were recently held.

In one of the small sketches is shown the extreme north end of one of the panels at the sides of the eastern entrance to the Transportation Building. It was the intention of the designer to have this particular part of the panel typify the electric method of transportation, but it is difficult to understand how such an ill-designed piece of work ever secured the approval of the authorities. The prominent position given to an oil cup on the end of what appears to be intended for a rheostat would seem to indicate that the designer meant to lubricate as much as possible, the path of the current before it reaches the indefinitely outlined machine that we must assume is an electric street railway motor.

Another of the illustrations shows the design of telegraph box now in place about the grounds, while still another exhibits the large electro-magnet that adorns a niche at one side of the entrance to the Electricity Building.

Finances of the Fair.—The monthly statement contains a number of items of general interest. Guide books sold on the grounds at 10 cents each have netted a revenue of $2,849. Souvenir programmes sold dedication day amounted to $4,291. Badges for directors, National Commissioners and members of the chorus, dedication day, amounted to $1,343. The entire expenses of dedication ceremonies are put down at $72,320. Decorations in buildings cost $8,839.

The expenses of the construction department reach the surprising total of $9,612,026.89, of which $1,100,824.95 was paid out during October. The total expenditures for October were $1,233,536.01. The construction department has contracted for expenditures aggregating $11,951,057.21, on which $7,560,035.22 has been paid, leaving $4,391,021.99 due the contractors. The number of employés in October was 3,273, an increase of 466 over September. This, of course, does not include the laborers working for contractors. The average wages of employés was $79.80 per month.

RECEIPTS.

Balance received from temporary organization	$4,252.65
Received on current installments of stock subscriptions	5,317,088.60
Received from banks for interest on deposits	60,959.57
Received from city of Chicago on account of sale of bonds	5,003,726.03
Received for souvenir coins	113,775.00
Account of gate receipts at Jackson Park to Nov. 9.	160,113.26
Received account debenture bonds	1,447,500.00
Received for accrued interest on debenture bonds	37.00
Miscellaneous receipts from sundry sources	278,221 93
Received various stock subscriptions not yet classified, being amount of cash on hand to credit of temporary accounts	108 40
Total	$12,385,782.46

DISBURSEMENTS.

Total disbursements on vouchers	$11,536,933.54
Total available cash on hand to date	848,848.93
Total	$12,385,782.46

A GENERAL VIEW LOOKING NORTH ALONG THE EAST SIDE OF THE ELECTRICITY BUILDING—THE LIBERAL ARTS BUILDING ON THE RIGHT.

Auditor Ackerman's report made a good showing for Exposition subscribers. It indicated that 595,053 shares of stock have been subscribed for at $10 each. This would represent a capital stock of $5,950,530. Of this amount $5,375,336.80 has been paid, leaving a deficit up to this time of approximately 9.68 per cent. The figures on subscriptions are as follows:

2 per cent. on 27,112 shares	$5,422.40
20 per cent. on 11,630 shares	23,260.60
40 per cent. on 15,827 shares	63,308.00
60 per cent. on 21,636 shares	129,816.00
80 per cent. on 17,529 shares	140,232.00
100 per cent. on 501,319 shares	5,013,193.00
Installments in suspense	108.40
	$5,375,336.80

CHICAGO, Nov. 12, 1892. F. DE L.

Some of the Uses of the Search Lights.—I.

BY R. H. BACON.

The various accounts of the several manœuvres of late years, when touching on the subject of search lights, have more or less left a general impression of their inutility. Correspondents on both sides of the opposed forces have freely criticized them, and most naturally so, since experienced torpedo boat officers do not consider them a formidable deterrent, and the authorities in the larger ships are sceptical as to their utility as a means of warding off a torpedo boat attack. Without in any way being dogmatic it may be confidently asserted that considerable judgment is required before using a search light as a means of defence from a torpedo boat attack. It will be as well in explaining the peculiarities at tending the practical use of the search light on board ship to consider the conditions by which a boat becomes visible by night.

Objects on the water or against the horizon are visible solely by the contrast of their color or shade with that of their surroundings. Were the object exactly similar to its surroundings, naturally it would appear but as part of them, and be invisible. In bright sunshine it is impossible to imitate water so exactly in its varying color and shades as to render a boat absolutely invisible upon it; so much light is always present ready to be reflected from all parts of an object that slight variations are easily detected, but at night this is different. Smooth water at night, when lit up by a search light, appears very dark indeed, and naturally so, since to an observer near a projector but few rays are reflected back from the small ripples; the water, therefore, appears almost black. Now place on this an object which also reflects but little light to the observer, such as a "dead" black boat (one painted with black lead), and the contrast between the two is almost *nil*; in fact, so nearly may the two sets of reflected rays match one another as to leave the boat, though in the centre of the beam, practically invisible from the ship. It is not sufficient to merely let the beam fall on the boat, but to see it is necessary to produce a distinct difference between the light reflected by the boat and that reflected by the water. This at once explains a very common occurrence to all who have taken part in night attacks—that is, to find your boat brilliantly lighted by a search light beam, and yet for the beam to pass by harmlessly without the boat being observed by the ship. Nor is this all. Observers on board the ship are to a certain extent dazzled by the brilliancy of the beam even when at some considerable lateral distance, since the particles of moisture or dust in the air reflect and diffuse light to a considerable extent, and an effect is produced similar to, but, of course, to a less extent, that of looking out of a light room into a dark night; the exact extent of the effect is determined by the angular position of the observer from the projector and object. There is yet another effect that limits the distinct vision of an observer near a projector, and that is the fact that when near a projector the rays reflected from an object have to travel back for some distance through the beam—that is, they suffer from considerable interference. The result is that the object appears indistinct. It will be easily seen that all these effects greatly reduce the efficient use of a search light when used to pick up an object if the observer is near the projector.

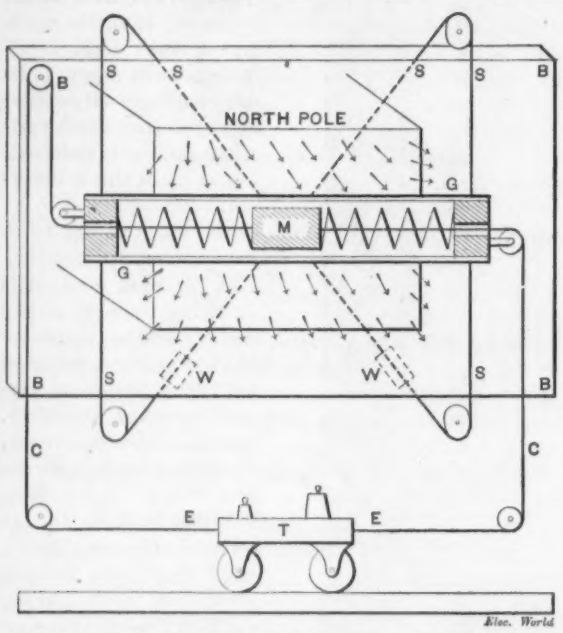
A Lecture Apparatus for Illustrating the Elementary Principle of Dynamos and Motors.

BY CARL HERING.

In a course of elementary lectures on electrical subjects, delivered some years ago, the writer had occasion to illustrate the underlying principle of the generation of an electric current in a dynamo and the generation of power in a motor. In order to show this to a large room full of people it was thought best to use a mechanical model instead of the usual electrical apparatus, because it was simpler, more readily visible, and because the action of a purely mechanical model involving no preliminary knowledge of the detecting galvanometer, multiplying coils, etc., could be more readily grasped by a beginner. A crude mechanical apparatus was, therefore, constructed, which appears to cover a number of the points which beginners sometimes have difficulty in understanding from mere verbal statements, and which are not always easily shown with simple electrical apparatus. At the request of a number of those who saw it, a description of this model is given below with the thought that it may be of use to others for instruction and lecture purposes.

The purpose of the apparatus is to illustrate by a purely mechanical contrivance how a current, or more correctly an electromotive force, is generated in a conductor when it is made to cut lines of force, as in a dynamo.

On a vertical board *BBBB*, in the adjoining figure. the north pole of a large magnet is drawn, the direction of the magnetism, that is, the lines of force being shown by means of arrows. A strong glass tube *G G* is supported on strings *S S* passing over pulleys at the top and bottom as shown, and crossing each other on the back of the board, thus enabling the tube to be moved easily up and down across the board, always keeping parallel to itself. It will readily be seen that by merely moving one end of this tube up or down



Lecture Apparatus for Illustrating Induction.

the whole tube will move parallel to itself. Counterweights *W W*, attached to these strings, as shown, balance the weight of the tube.

The glass tube is closed with a perforated plug at each end and contains in the inside an open spiral spring evenly wound and made preferably of a black steel wire so as to be readily visible. This spring fills the whole tube but fits it so loosely as to allow being readily moved longitudinally. The block *M* secured to the middle point of this spring has cords attached to it which pass longitudinally through the tube, out through the ends and over the pulleys, as shown, to a small traveling tray *T* on rollers. A longitudinal motion of the block in the tube will therefore cause this tray to move in one or the other direction. The tray can be weighted and its track be inclined so as to give it a tendency to move in one direction. All the pulleys should be as large as possible to give the least amount of friction.

Before using the apparatus it is well to explain to the student that an electric current is caused by an electromotive force and that the object of the dynamo is to generate this electromotive force, the resulting current being then dependent on other conditions outside of the dynamo. It will then be found easier to explain other matters, than if it is taught that the dynamo generates current directly.

To illustrate the application, let the tube be moved rapidly in a downward direction over the end of the diagrammatic magnet. Owing to the inertia of the tray *T* the block *M* cannot respond so quickly, and will, therefore, move to the left in the tube, thereby compressing the spring in the left-hand end and expanding it in the right-hand end. As the spring is black these compressions and expansions are readily visible, even at some distance. Assuming for simplicity, as is usually done in illustrating elementary principles, that an electric current flows out of a positive pole and into a negative one,* a compression of the spring is explained to represent a positive charge or accumulation of electricity and an expansion to represent a negative charge or rarefaction. A downward motion across a north pole will therefore generate an electromotive force in the moving wire which is positive in the left hand end and negative in the other. A movement of the tube in the opposite direction will evidently produce compression in the right-hand end and expansion in the other. Furthermore a rapidly oscillating motion to and fro will produce alternating electromotive forces. The first law of induction is thereby illustrated. The block *M* may also be said to move in the direction in which the current tends to travel in the conductor itself.

By moving the tube slowly, only a small difference in the amount of compression and expansion of the spring will be produced, while if moved rapidly it will be greater. This illustrates the second law that the electromotive force generated depends on the speed at which the wire is moved past the pole.

It must now be explained to the student that increasing the inertia of the block *M*, which may be done by increasing the weights on the tray in the model, is analogous to increasing the magnetism of the pole. Then by adding weights on this tray and moving the tube with the same velocity as before, the compression and expansion will be found to be increased, showing the effect that the strength of the pole has on the generation of the electromotive force, thereby illustrating another law of induction.

Moving the tube and then stopping it suddenly will show that the electromotive force generated during the motion, ceases and disappears by equalizing itself again in the wire as soon as the motion stops.

To illustrate the elementary principle in a motor, set the board on which the tray travels, on an incline, so that the tray will tend to move, say, to the right. This will compress the spring in the left-hand end of the tube and expand it in the other, which, as before, represents the presence of an electromotive force or current. If the spring is sufficiently strong, the tube will now move upward across the pole, showing how a wire through which a current is passed will tend to move through a magnetic field. An inclination in the opposite direction will evidently produce a downward motion. The effect of increasing the weight on the tray (or its equivalent, the inclination) is now analogous to increasing the electromotive force or the current which drives the motor.

But the model will illustrate still further the action in a motor. Suppose, as above, that there is compression in the left-hand end of the tube, causing an upward motion. Now this motion will in itself tend to produce compression in the right-hand end, as can be readily shown—that is, the motion of the wire in the field will tend to produce a counter or opposing electromotive force which tends to neutralize that from the outside. The faster this tube is allowed to move, that is, the less the mechanical resistance opposing its motion, the greater will be this counter electromotive force, while the slower it is allowed to move the less will it be, precisely as in a motor. Furthermore, the distance at which the block *M* is maintained from the centre of the tube during such motion will represent the current. The further it is to one side the greater is the tendency to move, corresponding to the torque of a motor; while when the block is near the centre (which will be the case when the speed is greatest) it shows that the two electromotive forces are nearly equal and the current small, while the tendency to move will be less.

The same model may be used also to show some features of alternating currents, though its application in this direction may perhaps be of less interest and the analogy less perfect. A movement of the tray by hand will as before represent an electromotive force from an exterior source, in this case the impressed electromotive force, and the motion of the tube will indicate in a measure the effect of such an electromotive force in a wire which is in a magnetic field; but now the field generated by the current itself, as, for instance, that of a coil, or in a transformer, must also be considered as making up the field surrounding the wire. In this application, weighting the tube or the cords guiding it, being careful to counterbalance such weights, will act in a measure like increasing the field.

Suppose the tray be given a momentary movement or push, say, to the right; the tube will respond with an upward motion, but its movement will lag behind that of the tray, illustrating the lag behind the impressed electromotive force when a wire is in a magnetic field. Furthermore, this lag will be greater the greater the weights attached to the tube, which corresponds to the strength of the field.

If the tray be moved to and fro the motions of the tube will lag behind by a certain amount, depending on the inertia of the tube and on the rapidity of the reversals. By increasing its inertia or the speed, the resulting motion of the tube will be less and less, and it will be found to require less and less power to move the tray, until such a speed or inertia is reached that there is practically no resulting motion of the tube, in which case the only energy required to move the tray will be that to overcome the friction of the apparatus; that is, almost all of the energy will then be returned to the source. This illustrates how an electromotive force may be impressed on a coil and yet do practically no work. The latter is analogous to the action in the primary coil of a transformer which has an open secondary circuit. It should now be explained to the student that the effect of the current in the secondary of a transformer is, to a certain extent, to reduce the field. In the model, a reduction of the field strength by using fewer weights will be shown to increase the motion of the tube as well as the energy required to move the tray.

The same model may be used to illustrate still other features of alternating currents by placing springs at *E E* and weights on the cords *C C*, in which case the motion of the spring in the tube will itself lag behind that of the tray. These, as well as other modifications and elaborations may be added by the lecturer to any degree desired.

Regarding the illustration of certain alternating current phenomena by lecture models, attention is called to a more simple device described by the writer in The Electrical World Dec. 26, 1891, p. 467.

* An assumption which, though not correct, is as justifiable when used as a conventional assumption for teaching elementary principles, as is the use of the plus and minus signs to represent the terminals of a circuit or the poles of a magnet.

Railway Turnouts.

BY W. E. HARRINGTON, B. S.

The locating of turnouts on a single track railway requires a close study of the local conditions, the present and probable future business, the grades and crossings. If the railway were of an uniform level grade and the handling of passengers constant throughout its entire length, then we would have the most favorable conditions for locating the turnouts to operate the cars to the best advantage.

In all railways there are times when it is necessary to operate one or more cars in addition to the regular number; again in many railways the business is of a varying character throughout its length, running through both densely and sparsely populated districts. Under the above circumstances the locating of turnouts on the purely theoretical basis would be incorrect and would indirectly be the loss of a source of income due to the inefficient and decreased car service. It will be the purpose of this article to briefly discuss the points involved, and the laws governing the location of turnouts.

To illustrate the simplest method of graphically obtaining the location of turnouts we will take the case as shown in Fig. 1. We will assume a railway to operate four cars, the

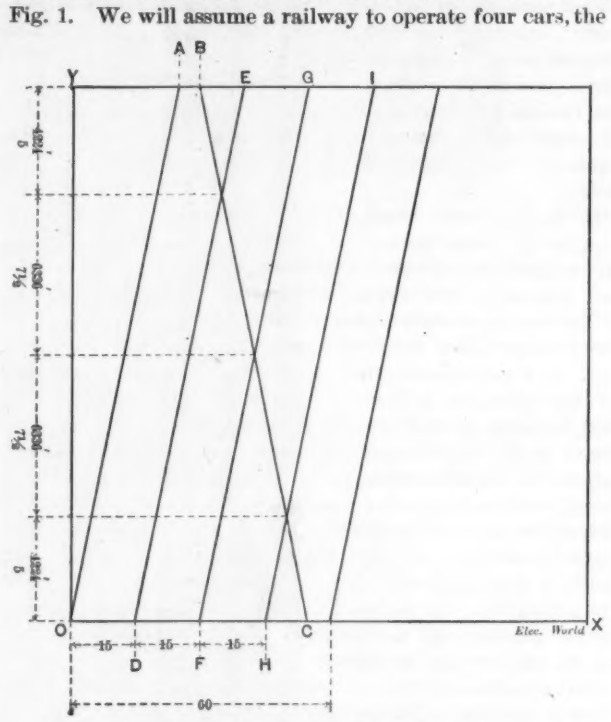


Fig. 1.—Location of Street Railway Turnouts.

distance between terminals being four miles, the time of round trip 60 minutes, and the time between each car 15 minutes, with a lay over at each end of five minutes. Take a piece of cross section paper and make the ordinates or vertical lines represent distance, and the abscissas or horizontal lines represent time.

Since the time of round trip is 60 minutes the time necessary to run from terminus to terminus is half of 60 minutes less ten minutes (the lay-over time) giving 25 minutes. Let each division on the ordinary axis represent the distance traversed by a car in one minute, which in the above case is 844.8 feet per minute, assuming that the car is to run at the average speed of 9.6 miles per hour. Let each division on the axis of abscissas represent five minutes. The first car will travel from terminus to terminus as represented by the diagonal line *OA*. This line shows the car's position at any instant of time, assuming, of course, that the car is running at a uniform rate of speed. The car upon its arrival at the other terminus will have a lay over of five minutes as represented by the horizontal space *AB*. Upon the expiration of the time of lay over the car starts upon its return run. This determines the locus of the several turnouts, as the car has to pass each of the remaining cars. The line of the return run is represented by the line *BC*. Upon the arrival of the car at the original terminus and a lay over of five minutes the cycle of trips will be repeated. During the time the first car is running its round trip the other cars are leaving at intervals of 15 minutes as represented by the lines *DE*, *FG* and *HI*. Where these three lines intersect the line *BC* turnouts must be located, as the cars meet and pass at these points. The distance apart of the turnouts as well as their distance from the starting terminus *O* may be readily determined by projecting the intersections on the axis of ordinates *OY*. This gives us the distance between turnouts as 7½ spaces, or 6,336 feet, and the distance between terminals and the first adjacent turnout as five spaces, or 4,224 feet.

We thus have a quick, ready means of determining the location of turnouts, which is applicable under circumstances similar to the above.

By studying Fig. 1 carefully, noting the time consumed by the cars during the interval between meetings, we de-

duce the following conclusions, which are absolute laws and can be used and applied in the various cases arising practically in the design of single track railways.

1. The number of turnouts for a given number of cars is one less than the number of cars running.

2. The time consumed running between turnouts must be the same between all the turnouts. For instance, if it is found necessary to irregularly locate turnouts for any reason, then the time consumed by a car running between those two turnouts farthest apart determines the time the cars must run between the remaining turnouts, even though two or more of the turnouts be only a slight fraction of the distance apart of the two greater ones.

3. The time consumed running between two consecutive turnouts is one-half the running time between cars.

It is interesting here to enunciate a rule for determining the distance apart of turnouts without the aid of graphical methods.

Rule.—To the length of the railway from terminus to terminus add the distance a car would travel running at the same rate of speed as running on the main line for the time of lay over at one terminus. Divide the above result by the number of cars desired to be run, the result is the distance between turnouts. Multiply this latter result by two less than the number of cars and deduct the result obtained from the length of the line from terminus to terminus and divide by two. The result is the distance from either terminus and the first adjacent turnout.

To operate more or less cars on a railway than it is designed for is a question most frequently met in railway practice.

Rule 1 tells us that we must have one turnout less than the number of cars running. In Fig. 1 we have four cars and three turnouts. If we propose running three cars we would use two turnouts by omitting the middle turnout. The result is at once apparent, for according to Rule 2 the time to run between turnouts is determined by the time consumed in running between those two turnouts farthest apart. Therefore since the distance is doubled the time consumed is doubled. Where with four cars with fifteen minutes between cars and 60 minutes for the round trip, with three cars the time between cars as by Rule 2 is 30 minutes, and the time of round trip is 90 minutes, making at once a very pronounced loss.

The better plan and the one usually pursued by railway managers is to run the lesser number of cars on the same trip time as the railway was designed for. In our example above the three cars would be run as if the four cars were running, with the exception that the space which the car should be running in will be omitted, leaving an interval between two of the cars of 30 minutes, giving only the loss occasioned by the omission of one car.

The best practice would be to have one or more cars to be used as extras for use upon the withdrawal of cars for any reason, but this is impossible on the majority of railways, owing to a shortsighted policy, which looks at the additional investment in the cars without looking at the gain and saving effected by the better car service.

Another method to pursue, especially so where additional cars will be run at times such as holidays, excursions and other times of travel requiring more than the regular number of cars to accommodate the travel, is to provide and locate more turnouts. The expense of doubling the number of turnouts, while they would be a great convenience, would not be warranted without the railway were doing a large and growing business, with a fluctuating number of cars in service. Two cases should be considered:

First—If a certain fixed number of cars are to be operated for the greater portion of time and the extra cars for odd and infrequent intervals, locate the turnouts to suit the regular business.

Second—In the case of a railway running an irregular number of cars—for instance, a railway running a heavy business at certain times of the day—as the lesser number of cars are subordinate to the greater number, locate the turnouts to run the greater number of cars the most efficiently.

In conclusion we might state that the grades, the running through crowded business streets, stoppages occasioned by grade railroad crossings, and varying business, all enter in and must be considered while designing. The whole matter of turnouts is exceedingly simple when the above rules are known, and without exception a railway cannot be operated satisfactorily unless the immediate managers are conversant with them.

A Quadruple Expansion Engine.

The first large quadruple expansion engine to be built in this country has just been undertaken by the Dixon Manufacturing Company, of Scranton, Pa., for the Edison Electric Illuminating Company, of New York City. It is to use steam at 210 pounds pressure, and is rated at 2,500 h. p. The cylinder diameters are 26, 37, 52 and 72 inches, with 36-inch stroke, and the speed will be 100 revolutions per minute, or 600 feet piston speed. The engine will be of the vertical inverted type, with the cylinders arranged in two tandem pairs, and the cranks 90 degrees apart. The dynamo to be run by this engine will be built up on the main shaft, and will, in fact, form the fly wheel of the machine. The designers of the engine are Messrs. J. Van Vleck, of the Edison company, and J. W. Sargent, of the Dixon Manufacturing Company.

On a Method of Balancing Armature Reactions.*

BY HARRIS J. RYAN.

The electric generators or motors are constructed in the ordinary manner, except that immediately back of the pole surfaces (see Fig. 1) holes are provided through which conductors are wound in such a manner and in such numbers that when the armature current passes through them from *A* to *B* their magnetizing effects at all points shall be equal and opposite to those of the current in the armature conductors. This method was devised by the writer and applied to actual designs three years ago. Recent examination of American patent records, however, discloses the fact that this method received some thought and attention, without practical development, as early as 1886.

The writer has been conducting an investigation of the practical application of this method to actual machines during the past two years. Through the valuable assistance of Mr. M. E. Thompson, fellow in electrical engineering, six machines have been designed, two of which are already constructed and the other four are well under way. Each machine represents a distinct line of practice. When the investigation is completed in accordance with the original plan the result will be fully published. In the meantime it may be well to mention the results thus far obtained.

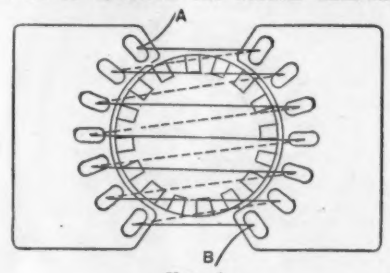


FIG. 1.

Though both machines behaved in a manner that was more than satisfactory, yet we will turn our attention to the second machine. This machine is illustrated in Fig. 2. It is a four-pole incandescent dynamo, for which we give the following data:

Output, 40 ampères at 100 volts and 1,200 revolutions per minute. Type of machine, 4 pole; field of cast iron in two pieces. Armature, drum winding through 58 grooves; 5 No. 10 B. & S. wires in each groove; winding in two circuits; 29 commutator bars; grooves milled out, size $\frac{3}{8}$ inch $\times$ $\frac{9}{64}$ inch; outside diameter of core $7\frac{1}{2}$ inches, inside 3 inches, built up of discs; surface of completed armature wound with No. 14 B. & S. iron wire. Length of armature and poles, 6 inches each. Effective length of iron in armature core, 5 inches. Magnetic leakage, 1.5 per cent. Field cores, 5 inches $\times$ 2 inches, with rounded ends; area, 9.14 square inches. Mean length of field, magnetic circuit, 12.5 inches. Magnetic density in the armature core, 5,400; in the air gap, 4,900; in the armature lugs, 8,400; in the field cores, 6,800. Field winding—Mean length of a turn, 15 inches; requisite exciting M. M. F. for field circuit, 910 ampère turns; for armature, 25 ampère turns; for air gap, 1,000 ampère turns; or a total of 1,935 ampère turns; requisite size of wire for excitation at 100 volts, 1,575 circular mils; size of wire adopted, No. 18 B. & S.; of this size enough was put on to bring the exciting current density down to 1,000 circular mils per ampère. Weight of the completed machine, 400 pounds. The number of balancing conductors applied in each pole face is given by the following proportion: The product of the armature conductors under a pole into the current in the same is equal to the product of the balancing conductors back of each pole face into the current (total armature current) through them.

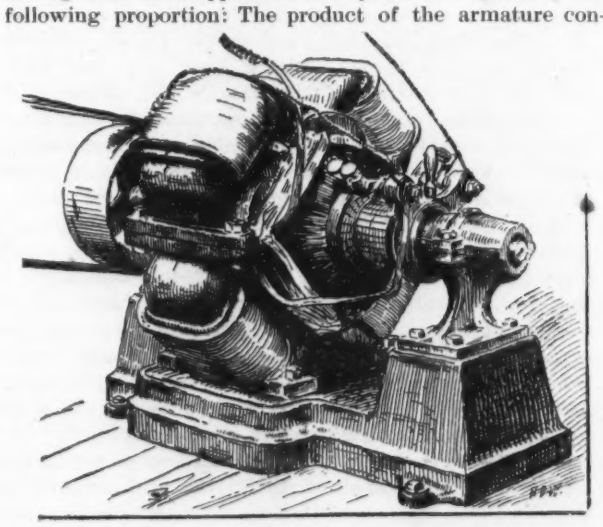


FIG. 2.

An examination of this data discloses the fact that no regard is had for the pernicious effects that are ordinarily met with in the use of so short an air gap with a comparatively large number of armature ampère turns. With the use of these balancing coils no such effects were observed; the machine performed precisely in accordance with the original estimates made in designing it, and exactly as theory shows that ordinary machines would perform if armature reaction were entirely absent. The poles cover 90 per cent. of the armature circumference, so that the effect of the back ampère turns was found to be quite negligible. The machine, when separately excited, could suddenly be loaded down to 100 ampères with an observed drop in E. M. F. at the brushes that would be no greater than the fall of potential due to the ohmic resistance of the armature. There was no shifting of the neutral point. When self-excited this drop was a trifle more, due to the lowering of the field excitation. Even at these excessive overloads the machine performed precisely as would a machine in which there is no armature reaction. At normal load the magnetic density in the air gap was observed at all points and found to be the same as at no load.

Considered as an ordinary machine without the balancing coils, it would be criticised as having too small an amount of materials in the make-up of the field cores, poles and field winding, with too large a number of ampère turns on the armature. This is amply emphasized by the actual performance of the machine when operated without the coils. The accompanying table gives the actual observations made in taking an external characteristic with the balancing coils cut out.

SPEED, 1,800 R. P. M.

E. M. F.	Current.	E. M. F.	Current.
120	27	64	34
100	32	50	30
90	32	32	22
88	36	26	20
85	37	14	12
73	36		

Even with the speed at 1,800 instead of 1,200, and with no added external resistance in the field exciting circuit at the higher current outputs it was not possible to get a greater output than 37 ampères at 85 volts.

In the performance of this machine, as well as in that of the first one that we constructed, we find that by the use of the balancing coils all cross induction may be avoided or it may even be reversed in its effects. In the first machine the number of balancing turns was variable, and it was found entirely possible to over compensate the armature reactive effects so as to get the strong pole corners where we ordinarily would get the weakened ones. We find with the use of the balancing coils that the magnetization through the poles, air gap and armature do not undergo a redistribution under any load; that the armature current does not alter the total magnetization through the armature at any value; that the neutral point remains constant; that the diameter of commutation with the metallic brushes changes only by the small amount necessary to balance the self-induction of the commutated section by the field in which it is moving; that regulation for constant current may be effected without change of the diameter of commutation by varying the magnetization through any limits; that by proper designing the output for a given weight in the completed machine may be quite largely increased over that which is realized in the common practice of to-day; and that the air gap may be made as small as mechanical requirements will permit without changing the performance of the machine, thus enabling one to realize practically the advantages of differential excitation that are utilized so successfully in the modern alternate current transformer.

*From the *Sibley Journal of Engineering*.

The Electrical Habits of Iron.

It is strange, says *Industries*, how little is known about the loss of power in iron under reversals of magnetization. It has been known for many years that energy was lost when iron was magnetized and demagnetized, but the builders of dynamos had no clear ideas on the subject. Seven years ago Prof. Ewing and Dr. Hopkinson called attention to the loss of energy by hysteresis, apart from Foucault currents; but since then no information of any practical importance has been added. It seems as if everything connected with alternating currents is doomed to go through a period of barren quasi-scientific treatment before being studied and utilized by electrical engineers. The quasi-scientific method of treating iron is to take curves with a ballistic galvanometer. This is a cumbrous method, and does not give the information required. The engineer really wants to know what kind of iron gives least loss by hysteresis, what maximum induction does it pay best to employ, and how much energy is wasted per cubic centimetre per cycle. To test a given sample the obvious way is to make a little choking coil of it, and to measure the power lost by means of a wattmeter. This gives the information at once as regards the sample. If readings are taken at different electromotive forces, the losses at different inductions are obtained. The ballistic galvanometer method is merely an indirect, and, perhaps, inaccurate way of arriving at the same result. Finding the qualities of different samples is a very small matter. The chief difficulty is to find good qualities of iron at reasonable prices, and what is wanted is the knowledge of the causes that go to make iron and mild steel good or bad. Makers of iron do not generally know anything about hysteresis, and electricians know little about iron, but it is no use shirking the subject and reading papers to scientific societies about curves belonging to specimens obtained at random from unknown sources. Reams of paper have been covered with researches on curves of random samples, and they are absolutely useless. They may be of scientific interest; if so, well and good, but they are generally supposed to be for the benefit of the benighted and ungrateful practical man. So far all the information the dynamo maker has is that soft iron has comparatively little loss by hysteresis, and he pins his faith on some particular merchant who supplies him with a metal which he calls "best Swedish charcoal iron," but which is not generally labeled "Made in Sweden."

A few investigators have given the analyses of their

samples, but we do not know whether the percentage of carbon is the salient quality, or whether minute traces of other substances increase or decrease the loss of power. Neither do we know how the treatment of the iron in rolling and annealing affects the magnetic properties. If investigators could only be induced to consider what practical people want to know, instead of what "looks deep in print," some useful information might be obtained.

The Drehstrom Patents.*

BY RANKIN KENNEDY.

Our esteemed contemporary *Industries* recently reviewed the position of the various claimants to the honor of having invented, or, perhaps, rather of having patented the drehstrom system of alternating working. The whole question, no doubt, will be threshed out in some law court, the issue being whether Tesla's patent is sweeping enough to rake in the improvements made during the past four years by those other inventors in the same field.

As one who has worked out a drehstrom motor, which I consider to be a totally different invention from Tesla's, I may be permitted to give my views on the subject. In the first place, let us see "what was Tesla's motor?"

It consisted essentially of two magnetic systems, one energized by one alternating current, the other energized by another alternating current, the two currents differing in phase by 90 degrees, and these two magnetic systems acting on an armature having closed coils. Diagram Fig. 1 is a simple illustration; a, b forms one of the magnetic systems, c, d the other, A is the armature.

The action of such a motor is very simple, although its action has been obscured by the volumes of mathematical analyses and investigations made into it, and also by the elaborate attempts to work out the rotary polar theory; its action is quite obviously simply the same as ordinary motors. The poles a, b are at a maximum at the same instant that the poles c, d are a minimum power, consequently the armature coils at that moment form a closed secondary circuit to the primary a, b, so that poles are induced in the armature by this secondary current, which are opposite in sign to a, b, but lag in phase behind a, b; the poles being opposite on armature, are repelled by a, b, and attracted round by c, d, which poles begin to strengthen as a, b weakens, till c, d are at a maximum strength and a, b at a minimum, when the same cycle begins again, thus producing rotation of the armature without a commutator.

Tesla also claims that if armature A were made into two armatures, placed side by side on the same shaft, and the poles a, b, acting on one of the armatures, and c, d, one of

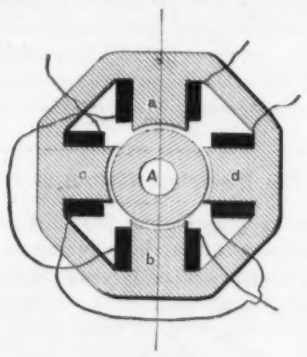


Fig. 1.

the pair of poles, being shifted along sideways to embrace one of the armatures acting on the other armature, both armature coils being connected electrically across, that construction would still be a Tesla motor; no doubt it would, but what becomes of the rotary polar theory?

The writer of this article constructed, and exhibited at Edinburgh Exhibition, a motor working with two Siemens drum armatures connected together to form closed circuits; these were acted on by two laminated magnets excited by two currents in quadrature. Such a construction comes under Mr. Tesla's claims. Under the best of conditions, however, this style of motor is a waster; it is not efficient, and does not start with a load, so that Tesla's claims don't concern it very much.

Another form was made afterward which proved considerably superior to Tesla's form. I described it in detail and illustrations, pp. 661 and 662, May 27, 1892, *Electrical Review*, London.

Other inventors have made improvements, and the question at issue between them and Tesla is whether such constructions came under Tesla's patent rights.

The general question for electrical engineers is of more importance to your readers, and that is, are multiphase Tesla or drehstrom motors "any good anyhow." The author's opinion is that they are no good—even the best of them yet designed. They have little or no great starting torque, and require enormous exciting currents.

Their only field of usefulness can be in transmitting small powers on board ships or in mines.

If ordinary high frequency is employed, such as is required for lighting purposes, then in motors such as these, wherein the field magnets are excited by the alternating current, the exciting current becomes too large. If the frequency is low, then the mutual induction is too low, and the motor becomes too large for the power it gives out.

Altogether the drehstrom motor has not so much to recommend it that would make it worth while fighting for it.

*From the *Electrical Review* (London).

Two and three-phase currents have more important applications than for driving motors. For transmitting electrical energy to a distance at high pressure, and afterward converting it into low pressure, continuous current for distribution seems to be a more promising application.

The alternating current motor, which has been a "long-felt want," is a small motor to work safely and efficiently on the present existing alternators, with no commutator, if possible; but with a commutator, if you like, provided no skilled attendance is required. If Tesla's motors can fill this want, why are they not in the market?

Large Fritsche Dynamo Armature for Direct Driving.

The accompanying figure, for which we are indebted to *Industries*, represents a large Fritsche armature for direct driving, in which connectors are employed, and the armature strips proper are radial. The armature conductors are again connected up in series, the method of coupling being easily seen from the illustration. Mr. Fritsche is said to

The Fritsche Armature.

be the first to investigate the laws of the numbers of turns necessary to produce series winding in multipolar dynamos. The connectors in the radial armatures are, of course, copper, and as the iron conductors are naturally large in comparison, it is easy to fit the connections in easily. These machines have been manufactured for some time of all sizes from 5,000 watts up to slow speed, direct coupled dynamos giving 200 h. p. each, for central station work.

The Siemens & Halske Electric Company of America.

(*From Our Regular Correspondent.*)

Early in the year this historic company located its general offices on the twelfth floor of the Monadnock block, corner of Dearborn and Jackson streets, and adjoining the Union League Club, and there President O. W. Meysenburg, Vice-President Aug. W. Wright, Treasurer Alex. von Babo and General Sales Agent J. Holt Gates established their headquarters. Work was then commenced on the factory, which is located on South Wood street, in the southwestern portion of Chicago, the entrance door of factory office being No. 1,166 Wood street. By the primitive horse car line it is rather a long trip out there, but the poor animals will shortly be displaced by a cable system excellent in every respect so far as it is possible for a cable line to have desirable and commendable virtues. Now the visitor boards the Blue Island avenue horse car on Madison street, and, after riding for about 40 minutes, leaves it at Wood street to walk south on a plank roadway through lines of lumber, and past dozens of new freight cars, built by the Wells-French company, to the new and substantial building erected where all the component materials for manufacturing electrical machinery are most easily accessible, where ground rent is low in value, where river and railway facilities for rapidly handling freight are unexcelled, and where extensions can be made as occasion demands at a minimum outlay.

Like everthing else pertaining to this firm of world-wide reputation, there is an air of stability about these buildings that conveys a comfortable feeling when entering, and thus no surprise is experienced when viewing the massive and ponderous machinery on every hand, or noticing the overhead electric crane dropping its hook into the link hanging from the drawbar of the last freight car and sending the train spinning through the shops and out along the track in the temporary absence of the shop locomotive.

And this same air of "sizeableness" is also apparent in the pattern room, where patterns are found for not only 5, 50 and 500 h. p. motors, but 1,000, 1,700, 2,500 and 4,500 h. p. machines, while the activity prevailing in the long, well-lighted draughting room, and in the very cleverly arranged blue-print room at the top of the building, where an abundance of light is secured, gives some indication of the rapidity with which orders for machines are being received, and of the special efforts that every one will have to exert to catch up in time to start fairly with the New Year.

Until now they have been largely dependent on the machinery department of the Wells & French company for such assistance as was required, but on Wednesday, Nov. 9, they lighted the fires under the great Heine boilers, and soon the pistons of the three big engines of the Lake Erie Williams type will be playing hide and seek in the steam-chest. Direct connected generators will supply the current that will drive armatures wound directly on the shafts of the machine tools, from the little drill to the big shaper and planer, thus rendering unnecessary the usual long lines of shafting. The same armatures will also supply the current to both arc and incandescent lamps at a normal potential of 100 volts.

At present all the heavy machinery is belted to line shafting driven by four Siemens & Halske large motors, and the change to direct driven will be made as rapidly as possible. Among the heavy machinery will be a large hydraulic press now on its way from Berlin, that is designed to be operated by steam for rapid work and by oil for slow, heavy pressure, as, for instance, in forging copper segments. Another heavy machine is the 16-foot lathe, for which the foundations are already in place.

Dr. Berliner, the chief electrician and superintendent of the factory, returned from Berlin last week, bringing the developed plans and photographs showing the new multiphase system completely worked out from one 10-h. p. to four 500-h. p. motors and for generators of corresponding size. Street railway motors will be built, including the gearless type, the single gear, the double gear, and the chain, all designed for multiphase work on long distance traffic, and ranging in size up to four 500-h. p.

Completion of the Plans of the Rapid Transit Commission.

The Rapid Transit Commission has finished the plans and specifications for the construction of the underground road in New York City, and will immediately publish them in detail and simultaneously advertise for bids. The advertisements will appear about three times a week and cover a period of six weeks, so that the date of the sale will probably be about Jan. 2. It is understood that the franchise is to be offered for 999 years, and that the contracting company will be exempt from taxes during the period of construction, which is limited as to the most important portion of the road to four or five years, and that the rates of fare are limited to five cents for a ride of any distance.

The matter has been before the public so long that the route of the proposed road as well as many of the details are well known. The line will extend from the Battery to Stuart's Lane, a distance of about 15 miles. There will be 35 stations, 10 of which are to be express stations, and all of them, with one or two exceptions, underground. The specifications call for a speed of not less than 40 miles per hour on the express lines, that is, the distance between the Battery and Fort George, which is about 10½ miles, will be covered in 20 minutes, allowing for stops.

The estimated cost is about $60,000,000 and the estimated expenses about $6,000,000 per year; the receipts are expected to amount to about $10,000,000. The question of the road being built by the city is under discussion, as it is claimed that the city would be able to borrow the money at a very much lower rate than private individuals could, and ensure the financial success of the undertaking.

The Niagara Falls Tunnel.

The Cataract Construction Company, which controls the water-power privileges at Niagara Falls, has determined upon the rates per horse power to be charged companies or individuals using power. About 3,000 h. p. for the Niagara Falls Paper Company is furnished at the extremely low price of $8 per year per 24-hour horse power. The ordinary rates for power are $10 per horse power for 5,000 h. p. or over, $10.50 for 4,500 h. p., $11 for 4,000 h. p., and so on down to $21 for 300 h. p.

An extension of the great tunnel 500 feet long has been determined on and the contract has been let. The extension, which is designed to bring into use for power purposes the land along the river near the Schlosser dock, will enter the eastern terminus of the present tunnel, taking a southeasterly direction. It is to be completed on Feb. 1 next. The connection between the wheel pit and the main tunnel is nearly completed.

Elementary Instruction in Electricity in New York City.

The class in practical electricity which was started early in October at the Young Men's Institute, 222 Bowery, New York City, has proved to be a very successful undertaking, and has become very popular. It now numbers nearly fifty members, and the regularity with which they attend the two exercises a week, and the interest they take in the work is very gratifying to the organizers of the class.

The Institute is very careful in the selection of instructors for its various classes, and its choice of a practical as well as a theoretical electrician to take charge of this course was a wise one. The instructor, Mr. H. A. Benedict, is a young man of ability and is well known among electrical concerns. He is a graduate of the Sibley College of Mechanical Engineering at Cornell University. Mr. Benedict spent his college vacations with the Westinghouse Electric Company, at Pittsburgh, Pa., and after his graduation accepted a position with the Brush company, at Cleveland, O. From there he went to the Thomson-Houston works at Lynn, Mass. Last spring Mr. Benedict was appointed an electrician in the Brooklyn Navy Yard, a position which

he now holds. Together with his wide experience and thorough knowledge as an electrician Mr. Benedict also brings to his work experience as a teacher, and his efforts with his class have been highly successful. The interest in the subject is so well sustained that there is little doubt that the course will be fully attended till its completion in the spring.

Earth Currents.*

BY WILLIAM FINN.

It has been noticed during the past half century that at intervals of 11 years or thereabouts the working of telegraph lines is always seriously impaired by a series of electric or magnetic storms which extend over periods varying from 3 to 8 months. They only occur, however, at intervals more or less irregular, and seldom last for more than a few hours at a time.

The disturbances at such times do not appear to be confined to any particular locality or country, but are found to exist simultaneously in nearly all parts of the world. It appears, moreover, that these periodical interruptions take place whenever the sun's photosphere becomes unduly excited, which happens most frequently during the periods of maximum sun spots—that is, at intervals averaging about 11 years. We are passing through one of those periods now, and thus far the year 1892 has been quite remarkable for the number and severity of its magnetic storm disturbances. It is evident, therefore, that an intimate relationship exists between the two phenomena, and the natural inference is that the solar perturbations are in some way responsible for the terrestrial effects observed. It will be interesting, therefore, to discuss the subject with a view to discovering as far as possible the nature of this relationship, and to ascertain the principles involved or laws concerned in connection therewith.

Magnetic or electric storms are so called because of the sudden appearance in the ground of natural currents of electricity of great volume and intensity which act directly by induction upon compass needles and magnetographs, and indirectly affect telegraphic apparatus through the coils of their main line instruments. These natural currents are known as abnormal earth currents, which do not differ materially from the manufactured currents of electricity, except in their singular characteristics and vagaries, which render them unsuitable for commercial purposes since they can neither be utilized nor controlled.

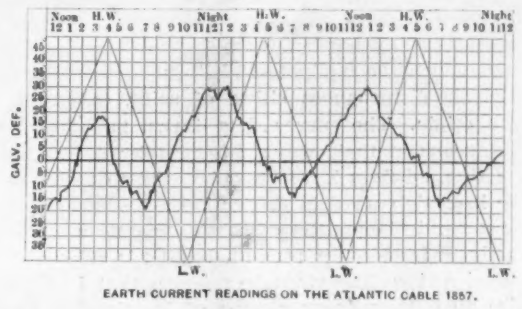
Artificial currents of electricity are always produced whenever electricity is set in motion under the action of an electrical force, just as water currents are established under the action of gravitating force. In order, therefore, that the earth's electricity may flow as natural currents from one place to another over the surface of the globe a difference of electrical level or potential must first be created between such places. Let us see in what particular manner this primary electrical condition is brought about so as to give rise to earth currents.

It is a well known fact that our globe is surrounded with what may be regarded as an atmosphere of electricity which acts inductively upon the combined electricities in the earth, and attracts or raises toward its surface the electricity of opposite name to that contained in the atmosphere. The aerial electricity is reacted upon by the opposite charge in the ground, and so long as this condition of stress is maintained between them the opposing electricities remain quiescent and impotent, like the electrical charges in a condenser. But when from any cause this strain is removed, the earth's electricity, which had been previously lifted to a higher level, as it were, rushes back to its original level in the form of an earth current. Whenever, therefore, the aerial charge becomes electrically excited, corresponding effects take place in the ground, through which currents of electricity flow whose magnitude and intensity will depend upon the nature and extent of the original inductive disturbance.

Now imagine one of those tremendous convulsions to be taking place in the sun with its accompanying electrical manifestations, which—judging from terrestrial analogies—may be properly assumed to be one of the characteristics of solar eruptions. The disturbance produced would be communicated to the ether, and by it transmitted like the waves of light—and at about the same velocity—until it reached our electrically enveloped sphere. Undulations or waves would then be started in the electrical atmosphere, which would induce corresponding impulses in the electricity of the earth, causing electrical waves or earth currents to travel through the earth and to enter the telegraph wires by means of their ground connections. During the prevalence of earth currents the surface of the globe is found to be divided up into a series of equipotential planes or surfaces, which may be roughly likened to the meridian lines drawn upon a map. Along any one of these planes the electric pressure is always the same at the same time, but between neighboring planes a difference of potential always exists. It is along lines of force running across these planes that the greatest interruptions are invariably felt.

You will have less difficulty in comprehending the principles involved if you consider for a moment the somewhat analagous case of a liquid disturbance. You all know that when the surface of water is agitated by dropping a stone into it there is generated a series of concentric circular waves which extend outward from the centre of disturbance. Now the direction in which such a disturbance propagates itself across these ring waves corresponds exactly with the direction of propagation of an electric disturbance across equipotential spheres or surfaces. Whenever the opposite grounds of a telegraph wire terminate on the same equipotential surface, the wire is not in the least affected by any disquieting force; but when they happen to be located on different surfaces, and lie along one of these lines of force, the wire is then liable to the greatest possible interference.

At times of violent solar excitement the disturbing elements give rise to those ever widening spherical impulses which are propagated through the ether of space and finally reach the earth, where the distribution of the



EARTH CURRENT READINGS ON THE ATLANTIC CABLE 1857.

FIG. 1.

equipotential planes is effected in the manner described. These planes generally run about north and south in this country, and it is on that account that telegraph lines extending in this direction are found comparatively free from interference during abnormal earth current visitations. On the other hand, as previously mentioned, those wires running at right angles to the equipotential planes experience the maximum disturbing effects, which accounts for our easterly and westerly circuits being the greatest sufferers at such times.

The magnitude of the forces developed in the wires evidently bears some relation to the length of the circuit, as might be naturally supposed, and experience shows that the maximum potential difference exists as a rule between the terminal grounds of our longest wires. During the past list of storms for instance, the circuits between New York and Buffalo, which vary from 450 to 482 miles in length, exhibited the highest electromotive forces, the value of which on several occasions exceeded 600 volts, and on Aug. 12 last reached the unprecedented magnitude of 768 volts. An idea of the intensity of this force may be judged from the fact that it is about equivalent to the electromotive force developed by 720 gravity cells, and represents more than four times the actual value of the voltage regularly employed on the particular circuit affected.

There have been no fewer than 13 magnetic storms which came under my own observation during the present year, three of which, viz., those of Feb. 13, July 16 and Aug. 12, were exceptionally severe and almost completely disorganized the entire telegraph service of the country during the time they lasted. The strength of the current on each of these occasions frequently exceeded 100 milliamperes, and occasionally rose to between 200 and 300 milliamperes. As the average

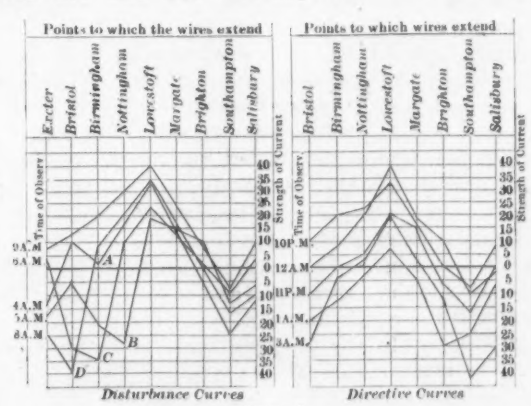

Points to which the wires extend
Exeter Bristol Birmingham Nottingham Lowestoft Margate Brighton Southampton Salisbury
Points to which wires extend
Bristol Birmingham Nottingham Lowestoft Margate Brighton Southampton Salisbury
Time of Observ.
Strength of Current
9 A.M 9 A.M 4 A.M 5 A.M 8 A.M
10 P.M 12 A.M 1 P.M 1 A.M. 3 A.M.
A B C D
Disturbance Curves
Directive Curves

FIG. 2.

strength of the working currents does not exceed 35 milliamperes, it will be readily understood that any attempt to maintain the ordinary working conditions under such circumstances was simply out of the question. It is sometimes possible, however, to do a little experimental operating by detaching the regular batteries from the wires and utilizing the natural forces alone for signalling purposes, but they are too capricious and unstable, as a rule, to be of much service in that way.

It was previously remarked that the distribution of the equipotential planes was usually found in a direction about north and south, but twice or thrice during the recent storm period there appeared to be a sudden shifting of the planes to an easterly and westerly direction, which is quite an unusual as well as remarkable circumstance, and one quite difficult to properly account for. At the times referred to the wires north and south which had previously experienced little or no interference became totally unworkable, whereas the easterly and westerly route appeared to be more or less clear of the earth currents. There were times also when a number of wires between the same points would be influenced in such a manner that while one or two might be found perfectly workable, the rest could not be operated at all. These curious anomalies, together with other strange inconsistencies that were noted at the time, can only be explained on the supposition that some of the equipotential lines instead of forming portions of spherical surfaces were more or less distorted by the action of other disturbing influences into highly irregular figures, such as the spectrum of one magnet would show in the presence of other magnets. Irregular curves formed in this way and passing through the various points noted—all being necessarily at the same potential—would render possible the maintenance of regular communication between such points.

There are many other interesting and important matters associated with sun spot phenomena, such as the auroral displays and the influence exerted on terrestrial magnetism, etc., that might be considered if time permitted, but I must leave the subject now in order to direct your attention to another class of earth current which differs in nearly every respect from that we have just been discussing. I refer to those feeble normal earth currents which are always to be found traversing the earth's surface, and whose interesting features may be studied at any time by inserting a galvanometer in any telegraph circuit from which the regular battery has been removed. Long and careful observations made in this way have established the fact that these currents have perfectly uniform motions, which appear to be controlled by some occult force, and subject to some general law. The normal currents do not in any way disturb the working of the wires, for instead of being strong and fluctuating, like the abnormal currents of an electric storm, they are exceedingly weak and vary with a sluggish wavelike pulsation. These facts became known to electricians at a very early period in the history of telegraphy, and caused many inquiring minds to seek a cause for the results observed. One of the earliest and most plausible explanations of the phenomena was based on the principle of the thermopile, viz., that currents generated by heat were set up in the ground by the action of the sun, which kept opposite portions of the earth at different temperatures. It was a fact well known at the time that a current of electricity could be maintained in a closed circuit comprising any combination of dissimilar metals provided opposite parts of the system were kept in different thermal conditions.

Reasoning by analogy the earth was regarded as a huge heterogeneous conducting body whose opposite sides presented the thermal inequalities so necessary for the production and maintenance of thermo electric currents.

Unfortunately for this very simple and beautiful theory it did not fully harmonize with all the peculiarities exhibited by the normal currents, so that other explanations and theories had to be sought more in accordance with the facts observed.

Now it had been noticed that whenever a number of readings were simultaneously taken on different wires and reproduced in a graphical form, there was usually a very remarkable correspondence in the contour of all the curves, which, as a rule, presented an undulatory or wavelike appearance. It thus became evident that natural currents of electricity were regularly and continuously sweeping over the surface of the earth, so that the fluctuations noted on any one wire afforded a sort of index of their features and variations in all other wires. The characteristics exhibited by the currents partook somewhat of the nature of a regular rise and fall like the ebb and flow of ocean tides. This singular appearance suggested the idea of a lunar origin, and the experiments and observations that have been subsequently made appear to fully substantiate the correctness of that view. It will not be difficult for you to form a sort of general idea as to the manner in which the differing positions of the moon in relation to the earth's surface affect our electrical atmosphere, inasmuch as the actions correspond in a manner with those of the tidal variations of the waters of the globe. Imagine for instance the electricity of the air to be lifted up, so to speak, by the attraction of the moon and dragged around by that body in its elliptical path around the earth.

Consider also that the earth by her rotation presents any given point on its surface to all parts of the lunar orbit during the course of a lunar day. Then, since the motions of the aerial electricity induce corresponding movements of electricity in the ground, it will be evident that places on the earth's surface directly opposite our satellite will experience high electrical tides, as well as all the other phases resulting from the circling motions and relative positions of the two bodies and possibly also to the position of the sun.

I shall presently show you a diagrammatic reproduction of some earth current readings which were taken upon a portion of the Atlantic cable in 1857, and which very beautifully illustrate these electrical tidal effects. The submerged cable had parted in mid-ocean and was consequently useless for regular purposes, so the opportunity was seized to make tests of earth current fluctuations and analyze the results. A galvanometer was inserted in the grounded cable at the Valentia end of the circuit, where the direction and strength of the earth currents

* A paper read before the Brooklyn Institute of Arts and Sciences, Friday, Nov. 4th.

were noted about once every 15 minutes for a period of 36 hours. The readings thus obtained are reproduced in the form of curves (Fig. 1) which when compared with the ordinary tidal curves for the corresponding period present coincidences so very significant as to leave little room for doubt that the same cause was concerned in both effects.

Not the least interesting feature of the normal currents is the fact that it is possible by a study of their variation and directive curves to discern the existence of temporary local disturbances, such as might be brought about by earthquakes, chemical action, compression or expansion, etc., and to define the area over which they extend, and the time for which they last. As the manner in which this is accomplished is somewhat complicated in detail, I shall content myself with simply showing you the difference in appearance between the undisturbed outlines of the regular variations and those that have been subject to interference by localisms of the character named. In Fig. 2 you will notice a practical uniformity of undulation in all the figures presented on the right of the diagram, while the other curves—reduced from readings taken over other wires at the same time—display certain characteristic deviations which when analyzed plainly indicate the period of duration of the local forces as well as the extent of territory affected by them.

The subject of local interferences leads me to the consideration of their effects upon the working of telegraph lines. For years past I have noticed the existence of a class of earth current which is neither very weak, like the normal currents, nor particularly strong, like the abnormal ones, but of sufficient energy nevertheless to militate against the successful operation of circuits under certain conditions of working. When the circumstances are favorable a main line relay is more or less insensible to small variations of current strength; but when the working margin is reduced, or approaches the vanishing point—as not infrequently happens—the relay becomes more and more susceptible to these fluctuations, and it is at such times that this intermediate class of earth current whose strength may not exceed 3 or 4 milliamperes proves inimical to good working.

Let us suppose for example that the natural and artificial currents coincide in direction or polarity. In that case the signals on the relay will come heavier than usual or "sticky;" but if the two currents oppose each other, the resultant effect will either be that of lightening up the signals or of causing them to fade away entirely. Exactly the same characteristics are produced on the signals by electric storm currents, but in those particular cases the effects are so much more pronounced and general that their presence in the wires is immediately recognized, whereas the feebler currents of the medium class commingle with the ordinary currents and their very existence in the wires can only be proved by some special galvanometer test.

To what particular cause or series of causes these local disturbances may be due is a question to which at present no definite answer can be given. I have tried, but not very successfully, to associate them with electric light and power currents. They certainly do not arise from leakage or induction from neighboring wires, for just as soon as the distant ground is detached from the wire the earth currents vanish. Is it possible that in addition to the chemical or physical agencies previously suggested there may be earth currents generated from meteorological causes, such for example as might be supposed to result from the violent motion of immense bodies of water across the terrestrial lines of magnetic induction? It is well known that whenever a conducting body cuts across a field of force an electric current is set up in the conductor. In an electric light system, for instance, the currents are generated in the dynamo machine in virtue of the electromotive forces induced in the moving armature during its passage across the lines of force produced by the field magnets. Now the earth is known to act very much as though a huge magnet were thrust through the centre of the earth. Between the poles of this imaginary magnet a field of force extends whose magnetic lines of induction are indicated at any place on the earth's surface by the inclination of the dipping needle. Their direction through the atmosphere of this room for instance may be likened to a shower of rain falling at an angle of about 72°. It is possible to generate a current in a coil of wire by simply moving it across this terrestrial field of force so as to vary the number of imaginary lines enclosed by the coil. While in Buffalo some years ago I found that even the running water of the Niagara River which cuts the earth's lines of magnetic force at a certain angle was capable of producing weak currents in one of the telegraph wires that spanned the river at the point of its greatest velocity.

You will have no difficulty, therefore, in conceiving the possibility of the waters of the ocean during exceptionally stormy weather giving rise to comparatively strong currents. In the distribution of these currents some would undoubtedly find their way into telegraph lines at remote points, and might thus serve as bad weather indicators. In this connection I may mention that I have frequently noted exceptional variations in the value of earth currents at times when the weather was remarkably clear at the place of observation, but unusually stormy at sea at corresponding periods, which information was subsequently acquired through the reports of captains of incoming vessels, etc.

There may, of course, be nothing more than mere coincidence in this, and I simply mention the circumstances to show the possibilities in the case; but there are undoubtedly many features about the study of earth current phenomena that possess practical as well as theoretical points of importance if they could but be properly followed up.

In certain volcanic regions, for instance, earth currents have been utilized to give warning of impending danger from subterranean outbreaks which manifest themselves by affecting telephonic and other electrical apparatus.

Through the agency of earth currents it is always possible to foretell the advent of the aurora borealis and in this way they may become serviceable to science.

A systematic course of observation at places widely apart would render possible the construction of a map of the world or any section thereof, showing the places through which the equipotential lines pass during times of periodic disturbances either of solar, lunar, or terrestrial origin. The curves thus drawn might prove as advantageous in their way to telegraphy as the isobar and isothermal lines have proved useful to meteorology, or the isogonic curves in navigation.

The general phenomena of earth currents are but imperfectly understood at present, but their effects are so universal and so important to science, that it does not require an extraordinary stretch of imagination to conceive the possibility of an extended application of these currents to useful purposes at some future time. With some such prospect before us, and in view of the many remarkable applications of electricity in recent times, why may we not indulge the hope that further study and investigation may yet evolve consequences that cannot even be suspected at the present time?

NEW BOOKS.

Spon's Tables and Memoranda for Engineers. By J. T. Hurst. Price, 40c.; with cloth case, 50c. Spon & Chamberlain, New York, 1892.

This is the eleventh edition of this well known little pocketbook of tables and formulæ, and it needs no further introduction to the engineering public than to say that it contains 125 pages of information relating to the materials of construction and their manipulation in practice.

The Steam Engine: a Treatise on Steam Engines and Boilers. By Daniel Kinnear Clark. Two volumes. 1,556 pp.; 1,300 ills. Blackie & Son, Ltd., London and New York. 1891. Price, half calf, $16.

The work of the electrical engineer is such that he is almost daily called upon to solve problems which belong more properly to the field of steam engineering. It is therefore necessary for every electrical engineer to be as well posted regarding the latest and best steam engineering practice as he is in that part of his work he regards as more distinctively belonging to the electrical engineer. We take pleasure in recommending to electrical engineers for this purpose the elaborate work mentioned above. The character of its author, whose engineering experience, extending over nearly half a century, has well fitted him for the production of such an exhaustive work on the steam engine, and who is perhaps as widely known as any engineering writer of the present day, is a sufficient guarantee that the work is eminently practical in its nature, and that no material has been inserted whose importance has not first been carefully considered.

The work is divided into four main sections as follows: First, principles and performance of steam boilers; second, principles and performance of steam engines; third, the construction of steam boilers; fourth, the construction of steam engines. The work is intended to furnish a comprehensive, accurate and clearly written text book that would take into consideration all the recent developments in the principles and practice of the steam engine. It explains the fundamental principles and describes the present practice as shown in the construction and use of modern steam engines and boilers, whether stationary, portable, locomotive or marine. In the preparation of these volumes the author has availed himself of the numerous published records of investigations in British and American as well Continental practice, and has added to this the results of his own investigations for many years past. More than 100 steam engines and boilers are described in detail and illustrated when necessary.

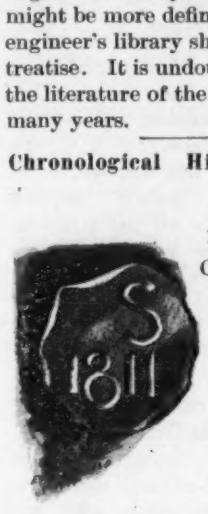
Chapters are devoted to the principles of riveting and the strength of riveted joints, the strength of shells and flat plate surfaces, the resistance of flue tubes, the equilibration or balancing of engines, valve gears, the action of governors, the behavior of steam in the cylinder, and the best proportions for cylinders single and compound. Matters such as the advantage of superheating steam, steam jacketing of cylinders, the best ratios for expansive working, the best periods of compression of steam in the cylinder are determined; while the merits of the Woolf engine versus the Receiver engine, compound engines, triple expansion, quadruple expansion engines, and other cognate subjects, are fully discussed.

The efficiency of steam boilers is fully investigated; the distribution of heat in the boiler, the relative effectiveness of different portions of the heating surface, and the best proportions for the evaporative performance. The various contrivances for effecting complete combustion of fuel and preventing smoke, the most suitable conditions for attaining that object, the principles of draught and the proportions for flues and chimneys, are fully considered in all their relations.

The work is profusely illustrated by more than 1,300 figures, consisting of engines, dynamos, detail diagrams and by a series of large plates of complete engines and boilers drawn to scale. A recent reviewer has said that no engineer's library is complete without this work, but we might be more definite than this and say that no electrical engineer's library should be without Mr. Clark's exhaustive treatise. It is undoubtedly the most important addition to the literature of the steam engine that has appeared for many years.

Chronological History of Electricity—Part II.—1800-1820.

BY P. F. MOTTELAY.



CHWEIGGER (Johann Salomo Christoph), a chemist of Halle, inserts at page 240, vol. ii., of his *Journal für Chemie und Physik*, the memoir of Sömmering, relative to his electrochemical telegraph, as well as an appendix thereto, wherein he points out the difficulties likely to attend the employment of so many different wires. He suggests the use of but two (instead of 27) wires, and of two piles of unequal power. With these, all desired characters could be transmitted, through a preconcerted code regarding the meaning of such letters and figures as would be represented by the weaker or the stronger pile, in conjunction with the duration of the gas evolutions or the space of time separating them. He also suggested, for an alarum, the use of a pistol, by connecting a battery to the pile.

Two months after Oersted's great discovery, which was announced in July, 1820, Schweigger read at Halle (September 16, 1820) and communicated to the German *Literary Gazette* (No. 296 for Nov., 1820), a paper relative to an important improvement made in his *galvano magnetic indicator*. The latter, which had been described at pages 206–208 of Gehlen's (1808) *Journal für Chemie, etc.*, was merely an electroscope, employed to indicate the attraction and repulsion of ordinary frictional electricity in lieu of a Coulomb balance. The improved apparatus was the result of his discovery that, by coiling an *insulated* wire several times around a magnetic needle, the deflecting power of the voltaic current increased with the number of turns.[1]

Alluding to Schweigger's multiplier, the Abbé Moigno says:

> A conducting wire twisted upon itself and forming one hundred turns will, when traversed by the same current, produce an effect one hundred times greater than a wire with a single turn: provided always that the electric fluid pass through circumvolutions of the wire without passing laterally from one contour to another.[2]

It was, however, shown by Dr. Seebeck that the power of multiplication does not increase with the number of windings in the uniting wire, for the resistance to transmission naturally increases with the length of the wire, thus diminishing its conducting power.

To his new improvement Schweigger gave the name of electro-magnetic multiplier (multiplicator) or galvanometer multiplier, and it has become the most important for indicating and measuring the strength of the galvanic current.

Prof. W. B. Rogers says that Schweigger's apparatus as improved by Nobili[3] became indispensable in the measurement of current electricity, and that through the later refined improvements given it by Sir William Thomson (and by Du Bois Reymond), it has been made one of the most perfect and delicate of all known means of measuring force.

Both Schweigger's multiplier and the improvements made thereon by Oersted and Nobili are illustrated at page 642, vol. xxi., of the Eighth "Ency. Britannica," where reference is made to the perspective drawings on a large scale shown at plate 322, article "Thermo-Electricity," of the "Edinburgh Encyclopedia."

According to a foot note, page 273 of "Report Smithsonian Inst." for 1873, Schweigger's multiplier is alluded to in the "Additions to Oersted's Electromagnetic Experiments," a memoir read at the *Naturforschenden Gesellschaft* at Halle, Sept. 16 and Nov. 4, 1820. An abstract of this paper was published in the *Allgemeine Literatur-Zietung* of Halle, (4to,) November, 1820, No. 296, vol. iii., col. 621–624, whilst the full memoir appeared in the *Journal für Chemie und Physik*, 1821, vol. xxxi., pp. 1–17; and "Additional Remarks. . . ." by Dr. Schweigger, in the same volume, pp. 35–41. It is further stated in the aforementioned note that:

> A galvanometer of somewhat different form, having a vertical helix and employing an unmagnetized needle, was very shortly afterward independently devised by Johann Christian Poggendorff, of Berlin; and as he preceded Schweigger in publishing an account of it, he is sometimes regarded as the original inventor.[4] Schweigger designated his device an "Electromagnetic Multiplicator;" Poggendorff designated his arrangement a "Galvano-magnetic Condensator." Professor Oersted remarks, "Immediately after the discovery of electromagnetism, M. Schweigger, professor at Halle, invented an apparatus admirably adapted for exhibiting by means of the magnetic needle the feeblest electric currents. . . . M. Poggendorff, a distinguished young savant, of Berlin, con-

[1] Kuhn, "Ang. Elek.-Lehre," p. 514.
[2] *Cornhill Magazine*, vol. ii., for 1860, pp. 61, 64.
[3] *Ital. Soc. Mem.*, vol. xx., p. 173.
[4] *Edinburgh Philosophical Journal*, July, 1821, vol. v., p. 113.

structed an electromagnetic multiplier very shortly after M. Schweigger, with which he made some striking experiments. M. Poggendorff's work having been cited in a book on electromagnetism by the celebrated M. Erman (published immediately after the discovery of these phenomena), became known to several philosophers before that of M. Schweigger."[5]

The researches of Schweigger and Bart leave us little or no doubt that the ancients were well acquainted with the mutual attraction of iron and the lodestone, as well as with the positive and negative properties of electricity, by whatever name they have called it. The reciprocal magnetic relations to the planetary orbs, which are all magnets, was with them an accepted fact, and aërolites were not only called by them magnetic stones, but used in the mysteries for purposes to which we now apply the magnet.[6]

In the editorship of Schweigger's *Journal*, which followed Gehlen's *Journal*, Mr. J. S. C. Schweigger was assisted, from 1828, by Franz W. Schweigger-Seidel, who was the author of "Lit. d. Math. Natur.," published in 1828.[7]

A. D. 1811.——Monsieur Dessaignes is the first to establish a relation between electricity and phosphorescence, as is shown in the extract published in London from the Memoir which he presented two years before to the French Institute. The general view which he takes of the phenomena therein described is that phosphorescence is produced by a particular fluid, which is set in motion by light, by heat, by electricity, as well as by friction, and that it is dissipated by overheating or by too long exposure to light.

It is asserted by Fahie[8] that it was Dessaignes and not Seebeck who first discovered thermo-electricity. "Dessaignes," he says, "showed us how difference of temperature or heat could produce electricity." This was in 1815, or six years before Seebeck, who is always credited with the observation.[9] Many observations bearing on *thermo-electricity* had been made even long before Dessaignes . . In 1759. Æpinus called attention to the same phenomena, and pointed out that electricity of opposite kinds was developed at opposite ends of the crystal (tourmaline). In 1760 Canton observed the same properties in the topaz; and between 1789 and 1791 Haüy showed the thermo electric properties of various other substances, as mesotype, prehnite, Iceland spar, and boracite.[10]

A. D. 1811.——The idea of placing a lightning conductor through the body of a ship is first suggested by Mr. Benjamin Cook, of Birmingham, and is carried out by Mr. William Snow Harris, of Plymouth. Mr. William Sturgeon, who mentions the fact,[11] adds that Mr. Harris "has formed the conductors into strips of copper, which are inserted in grooves in the after side of the masts from top to bottom and through the keelson to the sea. In one of the smaller men-of-war Mr. Harris carried his mizzen conductor through the powder magazine!!! The evils attending these conductors arise principally from lateral explosions and electromagnetic influence."

A. D. 1811.——In the first volume of his "Cosmos" (London, 1849, vol. i., pp. 240, 241) Humboldt speaks of *islands of eruption*, or marine volcanoes, which can properly be classed among electrical phenomena, and alludes to the one observed on the 13th of June, 1811, by Captain Tillard (Tillard), and to which he gave the name "Sabrina."

A. D. 1811-1812.——Schübler (Gustav), Professor, of Tubingen, is the first to present a connected series of observations upon the electricity of the air, which were made at Stuttgart, during all kinds of weather and at regular daily intervals, between May, 1811, and June, 1812. Other observations previously carried on by Schübler during 1805 and the subsequent years at Ellvanguen and Stuttgart are detailed at pp. 579, 580, vol. viii., and are also alluded to in article "Meteorology" of the Eighth "Britannica."

While Delor was the first to observe, in 1752, the existence of electricity in the atmosphere, even when no lightning is visible, Schübler made the earliest report upon the daily periodicity of the intensity of the electricity, the annual periodicity having been previously demonstrated by G. B. Beccaria, who published at Turin two able treatises embracing the subject during 1769 and 1775. The origin of atmospheric electricity was attributed by Lavoisier and Laplace, and Sir H. Davy, in great part to the constant combustion taking place upon the earth's surface; Volta and Saussure believed it to arise from the process of evaporation, and Pouillet pointed out the influence of the processes of vegetation, but Reich showed that as neither developed electricity they could not produce it in the atmosphere. Peltier advanced the theory that mere evaporation without chemical action is not enough, while the experiments of Faraday and Armstrong showed that evaporation without friction is likewise insufficient. These theories are treated of in "Gaea-Natur und Leben," Köln and Leipsic, 1873, p. 322, and in Lardner's "Popular Lectures," 1859, vol. ii., pp. 149–160. The last named gives tables of many observations and reports, among other results the fact that the series of observations on the diurnal changes of atmospheric electricity which Schübler made, in 1811–1812, were repeated at Paris in 1830 by Mr. Arago, who obtained similar results. Thus, in the month of March, 1811, Schübler found that the mean time of the morning maximum was 8 hours 30 minutes, and Mr. Arago found the mean time for the same month 8 hours 48 minntes.[12]

A. D. 1811-1818.——Ure (Andrew), M. D., F. R. S., the first astronomer appointed to the Glasgow Observatory, author of a Dictionary of Chemistry which remained the undisputed standard until the appearance of a similar work by Henry Watts, makes known the result of his electrical experiments in the same line as those made by Aldini (A. D. 1793) upon the body of a recently executed criminal. Noad, who gives a greatly detailed account of the investigations, at pp. 338–341 of his "Manual," remarks that they "serve to convey a tolerably accurate idea of the wonderful physiological effects of the electrical agent, and will be impressive from their conveying the most terrific expressions of human passion and human agency."[13]

Dr. Ure is the inventor of an improved endiometer, for detonating or exploding gases by means of an electric shock or spark, which is fully described and illustrated in the "Electricity" article of the "Britannica."[14]

A. D. 1812.——Through the *New York Columbian*, of July, 1812, Mr. Christopher Colles informs the public that, having completed his telegraphs, "Their operations will be shown from the top of the Custom House on Tuesdays, Thursdays and Saturdays from four to six o'clock in the afternoon."

In an explanatory pamphlet, he states that "Eighty-four letters can be exhibited by this machine in five minutes, to the distance of one telegraphic station averaged at 10 miles, and by the same proportion a distance of 2,600 miles in 15 minutes, 28 seconds."

Mr. James D. Reid, who mentions this fact at page 5 of his "Telegraph in America," says that the above was nothing but the already well-known European semaphore or visual signal, and that Colles worked his "machine" between New York and Sandy Hook for several years.

A. D. 1812.——On April 1st and 15th, May 15th and June 17th, Mr. M. Donovan, secretary of the Kirwanian Society of Dublin, reads before the latter body a long paper "On the Inadequacy of the Hypothesis at Present Received to Account for the Phenomena of Electricity," which was afterward ably criticised by Mr. J. A. De Luc, as will be seen by reference to the *Philosophical Magazine*, vols. xlv., pp. 97, 200, 329–332, and xlvi., pp. 13, 14. In his treatment of Eeles' hypothesis, Mr. Donovan gives some attention to the designed suppression by Priestley of Mr. Eeles' valuable papers from the *Philosophical Transactions*. (See A. D. 1755).

The above was followed by a still more valuable paper, read by Mr. Donovan before the same society, February 22, March 8, and March 22, 1815, entitled "On the Origin, Progress and Present State of Galvanism . . . and Inadequacy of the Hypotheses to Explain Its Phenomena . . .," a modified form of which obtained for its author the prize of the Irish Royal Society.

The last named important sketch of the history of galvanism is divided into three periods. The first treats of the discoveries attaching to muscular contraction, and alludes to the observations of Sulzer, Galvani, Fabbroni, Humboldt, Pfaff, Fontana, Valli, Monro, Vassalli-Eandi, Fowler, Smuch, Marsigli, Grapengiesser, Giulio, Rossi, Aldini and Wells. The second period reviews the gradual development of the physical and chemical power of combined galvanic arrangements, beginning with Nicholson and Carlisle, and refers to the conclusions reached by Cruikshanks, Henry, Haldane, Davy, Ritter, Robertson, Brugnatelli, Fourcroy, Vaûquelin, Thénard, Lehot, Tromsdorff, Simon, Helwige (Major Helvig), Twast, Bouiguet, Erman, Grapengiesser, Wollaston, Davy, Pfaff, Van Marum, Biot, Cuvier, Desormes, Bostock, Cuthbertson, Aldini, Lagrave, Jordon, Ritter and Wilkinson. The third period commences with the well known generalizations of the chemical effects of galvanism made by Hisinger and Berzelius; their experiments on the invisible transfer of elements at a distance, and the explanation given by Grotthus of the invisible transfer of the elements of water. Following this, Donovan alludes to the announced decomposition of muriatic acid by W. Peel, Francis Pacchiani, and others, as well as the discovery of the source of mistakes by the Galvanic Society, by Pfaff, Biot, Thénard and Davy; after which reference is made to the special observations of Sylvester, Grotthus, Wilson, Erman, Davy, Pontin, Gay-Lussac and Thénard, Children De Luc, Singer, Murray and Maycock.

On the 5th of April, 1815, Mr. Donovan reviewed the hypotheses of Volta and Fabbroni, as well as of the British philosophers Wollaston, Bostock and Davy, and, on the 19th of the same month, he read an additional paper on the inadequacy of the galvanic hypothesis, having previously (Dec. 28, 1814, and Jan. 11, 1815) presented to the Kirwanian Society a communication relative to a new theory of Galvanism.[15]

A. D. 1812.——Zamboni (Giuseppe), Italian physicist, professor of natural philosophy in the Verona Lyceum, makes known through his "*Della pila elettrica a secco*" an improved method of constructing dry piles. He dispenses entirely with the zinc plates of De Luc and employs only discs of paper having one side tinned and the other coated with a thin layer of black oxide of manganese pulverized in a mixture of flour and milk.[16]

His pile terminates in metallic plates, which compress the paper discs by means of silk ligatures, and the column is insulated by giving it a coating of sulphur or shellac. In this apparatus the tinned surface is the positive element the negative being the oxide of manganese, which replaces Mr. De Luc's Dutch gilt paper. In later forms of Zamboni's pile the discs were formed of gilt and silver paper pasted back to back. William Sturgeon remarks[16] that the Zamboni piles are those which have been the most securely protected against the action of the ambient air and are those which alone have maintained their original electrical intensity.[17]

Electric Stations as Insurance Risks.

Mr. Geo. P. Low, electrical inspector for the Pacific Insurance Union, has sent out a copy of the following letter to each electric lighting and railway station within the jurisdiction of that association. The letter will explain itself.

I have been asked to prepare a paper on "Electric Stations as Insurance Risks" for the coming annual meeting of the Fire Underwriters' Association of the Pacific, and inasmuch as you are most certainly interested in securing a proper understanding by fire underwriters of the central station as a fire risk, I take the liberty of asking your assistance in the preparation of the paper named.

You must be aware that the belief is growing among fire underwriters that electric light stations as a class are very undesirable risks; and I think you will concur with me in the opinion that this belief is not as it should be. To refute it, and to prove such assertions as will be made, by carefully gathered and reliable statistics, will be the aim of the paper, the success of which will entirely depend upon the individual efforts of each company in answering fully and honestly each question asked. Of course, all correspondence will be strictly confidential and in no instance will the name of any company be mentioned, nor will a reference to any particular concern be made. Only aggregate results will be quoted.

What is desired is the detailed information which will be derived from your replies to the questions asked in the accompanying slip. If the conviction is to be carried that the properly constructed central station should not be classed as a hazardous risk, and if the benefits resulting from such a conviction are to be enjoyed, then you, and you personally, must assist me in the task I have undertaken. As an electrician and one most deeply interested in everything that will contribute to the advancement of electricity, I urge you to appreciate the importance to this effort to be made on behalf of electrical interests, and to reply fully to each question asked, using a separate slip for each year during which your station has been operated. I am sure this will afford an array of statistics that will prove conclusive.

The information is desired not later than Dec. 1 and the questions asked are as follows:

What is the valuation (cost) of your station building inclusive of real estate?
What is the valuation (cost) of all dynamos and electrical equipments contained therein?
What is the valuation (cost) of the boilers, engines and all machinery, other than electrical, contained therein?
In what year was the station erected?
Is the building of stone, brick, frame or corrugated iron?
What power do you use: steam or water, or both?
Is your power plant used for your station exclusively, or does it furnish power to some adjoining industry?
Or do you obtain power from an adjoining industry?
What is the nature of such adjoining industry?
What is your nearest or greatest exposure?
Is the plant contained in a building occupied by other industries, and what?
What is the amount of insurance carried for the year above named?
What did this insurance cost in premiums?
What gross losses by fire, if any, was sustained during the year named?
What insurance have you received on these losses?
Of above losses, what insurance loss, if any, was sustained by fires caused by electricity?
What insurance loss, if any, was sustained by fire from causes other than electricity?
What insurance loss was occasioned on dynamos alone?
What caused the fire in your station?
What is the character of your station: is it a light and power, or railway generating plant, or both?
Do you use the alternating or direct current system of incandescent lighting, or both?
Do you furnish arc lights?
What is the population of your city for the year above named?
Was your city in a healthy or unhealthy commercial condition during the year named?
Did it have a boom?

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[5] *Annales de Chimie et de Physique*, 1823, vol. xxii., pp. 358-360.

[6] "Isis Unveiled," vol. i., pp. 281, 282. See, also *Annales de Chimie et de Physique*, 1816, vol. ii., pp. 84, 86; Thos. Thomson, "An Outline of the Sciences . . ." London, 1830, chap. xv., p. 564; "Encycl. Brit.," seventh edition, "Voltaic Electricity," p. 687; *Polytechnisches Centralblatt; Sci. Am. Sup.*, No. 404, "Sturgeon's Scientific Researches," Bury, 1850, p. 19; L. F. Kaemtz, *Phil. Mag.*, vol. lxii., p. 441; Poggendorff, vol. ii., pp. 873-875; Du Moncel, "Expose . . ." vol. iii.; Whewell's "Hist. of Ind. Sci.," vol. ii., p. 251; "Abhandl. d. Naturf. Gesellsch. zu Halle" for 1853-6; Schweigger's *Journal für Chemie und Physik*, vol. ii., part 4, pp. 424-434, vol. x. for 1814 and vol. xxxviii., for 1823.

[7] For the joint magnetic work of J. S. C. Schweigger and Wilhelm Pfaff, see *Jour. f. Ch. u. Ph.*, band x., heft 1, for 1814

[8] "Hist. of El. Tel.," pp. xiv., 297.

[9] See Bostock's "History of Galvanism," London, 1818, p. 101.

[10] Priestley's "History of Electricity," 1767, pp. 514-326. For Dessaignes other observations, see J. Farrar "Elem. of Elec., Mag., and Electro-Mag." 1826, p. 125, and *Phil. Mag.*, vol. xliv., p. 313. See also *Phil. Mag.*, vol. xxxviii., p. 3; *Journal des Mines*, vol. xxvii., p. 213; Poggendorff, vol i., p. 563; "Cat. Sci. Pap. Roy. Soc.," vol. ii., pp. 272, 273; chap. iii., sec. iii., of the electricity article of the "Ency. Britannica."

[11] "Lectures of Electricity," London, 1842, page 208.

[12] See *Edin. Jour. of Sci.*, New Series, vol. iii.; *Biblio. Univers.* vol. xlii.; *Annales de Ch. et de Ph.* for 1816, vol. ii., p. 85; "Jahrbuch der Ch. und Ph.," 1829; Gilbert's *Annalen*, vols. xxxix., xlix., li.; Schweigger's *Journal*, vols. ii., p. 377; iii., p. 133; viii., pp. 21, 22, 25, 26, 28, 29; ix., pp. 348, 350, 351; xv., p. 130; xix., pp. 1 and 11; xxv., p. 249; xxxi., p. 39; *Jour. de Phys.*, vol, lxxv., p. 177, vol. lxxxiii., p. 184. "Lehrbuch der Meteor," L. F. Kaemtz, Halle, 1832, vol. i., p. 337, vol. ii., pp. 411, 414; "Annual of Sc. Disc.," for 1862, pp. 99-103; L. Palmieri in *Lum. Elec.*, Paris, Oct. 31, 1891, pp. 209-212; Sci. Pap. Roy. Soc.," vol. v., pp. 559-562; Poggendorff, vol. ii., p. 853; Report on Atmospheric Electricity by F. J. F. Duprez, 1858, part iii, chap. ii., pp. 363-368; Foggo, p. 124, vol. iv., of *Edinb Jour. Sci.*; J. J. Hemmer's observations at Mannheim from 1783 to 1787, Lehrbuch etc., vol. ii., p. 418, and the recorded investigations of De Luc, Girtannier, Mayer, Monge, Pouillet, Becquerel, De Tressan, Arago, De Saussure, Delezenne, Helwig and Kaemtz.

[13] Another report of these experiments appears at pp. 634, 635 of the "Encycl. Brit.," article on "Voltaic Electricity," in No. xii. of the *Journal Sci and Arts*, and at page 56, vol. liii., of the *Philosophical Magazine*.

[14] See De la Rive, "Treatise on Electricity," vol. ii., pp. 489-490, also "Encycl. Metropol.," vol. iv. (Galv.), p. 107.

[15] See *Phil. Mag.*, vols. xxxix., p. 396; xliv., pp. 331, 401; xlv., pp. 154, 222, 308, 381; xlvi., p. 401; xlvii., pp. 167, 204; also vol. xxxvii., pp. 227, 245, on Mr. Davy's erroneous hypothesis of electro-chemical affinity, and vols. xxii. and xxiii. of the *Trans. Royal Irish Academy* for Mr. Donovan's papers relating to improvements in the construction of galvanometers, on galvanometric deflections, etc., etc.

[16] "Note historique sur les piles sèches," *Annales de Chimie et de Physique*, vol. xi., p. 190.

[16] "Scientific Researches," Bury, 1850, p. 200.

[17] See Larousse, "Dict. Univ.," vol. xv. p. 1,452; K. F. A. Von Schreiber in Gilbert's *Annalen*, lv.; Placidus Heinrich, Schweigger's *Journal*, xv.; Gustav Schübler, "Uber Zamboni's Trocke Säule," 1815-1816; G. F. Parrot, Gilbert's *Annalen*, lv.; K. C. F. Jager in Gilbert's *Annalen*, vol. xlix. for 1815, pp. 47-63; De la Rive, "Treatise on Electricity," vol. ii., p. 852; A. M. Ampère, *Ann. de Chimie et de Phys.*, xxix; John Farrar, "Elem. of Electricity," etc." 1826, p. 179; Zamboni and Ambrogio Fusinieri, *Ann. . . . Reg. Lomb., Veneto*," vols. iv., pp. 128, 132, vi., pp. 31, 142, 143, 293; G. Resti-Ferrari, "Elettroscopio . . . del Zamboni;" *Ann . . . Reg., Lomb., Ven*," vols. ii., p. 229; iii., p. 290; "Verona Poligrafo" for 1831, p. 37; *Mem. Soc. Ital.*, vols. xxi., xxiii.; *Mem. dell' Istit. Veneto*, vol. ii., pp. 239, 251; G. A. Majocchi, *Annali di Fisica*, vol. viii., p. 14; "Comm. dell Ateneo di Brescia," 1832, p. 38; Sturgeon's "Researches," Bury, 1850, pp. 147, 199, etc., for observations of A. de la Rive and Francis Watkins; *Phil. Mag.*, vol. xiv., pp. 67, 261; *Ann. Ch. et Phys.* for May, 1816, vol. ii. pp. 76, etc., 82-87 and *Bibl. Britan* vol. lvii., p. 225; also vol. xl., p. 190. See, likewise, the references at Hachette (A. D. 1803), Dyckhoff (A. D. 1804), Maréchaux (A. D. 1806), De Luc (A. D. 1809), the illustration and description of Mr. Palmieri's dry pile in *Sci. Am. Supp.*, Nos. 512, 519, and the accounts of investigations made more particularly by M. M. Beetz, Belgration, Burstyn, Crosse, Du Bois Reymond, De La Rive, D'Arsonval Desruelles, Edelmann, Faraday, Gassiot, Gassner, Germain, Raoul, Guérin, Haussman, Keiser, Schübler, Minotto, Pollak, Reiss, Schmidt, Trouvé, Wagner, Watkins and Wolf.

Discussion of the Railway Papers at the American Institute of Electrical Engineers.

Owing to want of time and other reasons the discussion of three papers on "Electric Railways" read at the June meeting of the Institute at Chicago, was postponed at that time until the fall meeting in this city. The whole of the last meeting was devoted to this discussion, in which a number of electric railway engineers took part. As it was rather lengthy, and as some parts can hardly be said to have been a discussion of the original papers, we give below only an abstract.

DISCUSSION OF MR. PERRY'S PAPER ON "SERIES ELECTRIC TRACTION."*

Dr. CARY T. HUTCHINSON opened the discussion by quoting at some length from a circular issued by a company a number of years ago, which attempted at that time to introduce a series system. Regarding Mr. Perry's paper, he said:

I thought this plan had been abandoned by everybody long ago. I dare say there were not very many people there who were entirely familiar with the beginnings of the series system and with the curious claims that were put forward for it at the time. As Mr. Perry himself says, the thing works beautifully—on paper. I might add that it never will work anywhere but on paper. Some kind of movable switches must be used, with magnets to open and close them, with two circuits on the magnets. Trolley wheels have to run on and connect three wires at the same time, in many cases making contact with all of them. These wires of course have to be insulated when the trolley wheel is not on them. Altogether the thing is extremely complex, and, I can say, absolutely impracticable. In addition to this, of course, there are the objections which apply to any and all series systems—very serious objections. In using a constant current one must vary the potential difference at the car; a car which would take 100 amperes at 500 volts, as many do, will, if run on 40 amperes, require 1,250 volts. As one cannot run a dynamo over 5,000 volts with any sort of decency, it is necessary to section the line. The sections must be so short that it is impossible for two cars to be on the same section at the same time. For city work, therefore, the sections must be very short, which means more of these switches.

Mr. Perry neglects completely what probably is the most important objection to the series system—that is the motor itself. The constant current motor is a very different sort of thing from a constant potential motor. A constant potential motor can be run, of course, at double its nominal capacity for a short time, but when a constant current motor is at its point of maximum work—that is to say, when the brushes are in the maximum position—if the load is greater than that for which the machine is designed, it will at once come to a dead standstill. There is no margin of overload in a constant current motor, hence the machine must be built for the very greatest load it can ever possibly get. To regulate it one must vary the field or shift the brushes. Shifting the brushes causes sparking. One might shunt the magnetic circuit, but that means beastly magnetic design. Moreover, a series system is necessarily a double trolley system, and this of itself is enough to condemn it utterly, without regard to the numerous other objections cited.

Although it seems as if it were hardly worth while to resurrect this, yet certainly Mr. Perry does deserve a great deal of credit for the ingenuity with which he has worked it out. He has made a very readable article. It is well, however, to keep in mind that the only point at which it is even claimed the series system has the advantage is in the saving of copper. But the cost of copper, although a large item, is by no means the total cost, and even the reduction of the copper cost to one-half or one-fifth of its present value would not be such a great advantage as to counterbalance the other disadvantages which it entails.

Mr. SPRAGUE, among other things, said:

The series system of electric propulsion is absolutely dead. Every now and then an attempt is made to revive it. It has been tried on one or two roads in England. It has been tried on one or two roads in this country, but if I may make reference to Mr. Short's own work, his experience has been a suggestive one. He started five or six years ago on the series system in Denver and elsewhere, and about four years ago in West Virginia. It is dead.

DISCUSSION OF MR. LEONARD'S PAPER ON "A NEW SYSTEM OF ELECTRIC PROPULSION."†

Dr. HUTCHINSON after describing Mr. Leonard's system, calculated the efficiency, and arrived at the following conclusions:

The efficiency of the system after Mr. Leonard's figures, interpreted, will be 37.6 per cent. I have in the above purposely ignored field losses. They are 560 watts, equivalent to about 4.5 per cent. and the net efficiency becomes, say, 33 per cent. This is as against 54 per cent. which Mr. Leonard arrives at by guessing the individual losses. The efficiency of this same driving motor governed by rheostat will be 19 per cent. With commutated fields, from what I have shown above, it would probably be 27 per cent. The difference between 33 and 27, *i. e*, six per cent., is the gain in this case. This is trifling, and by no means worth the complication involved. It is clear on the face of it that in the first case, *i. e.*, running at full speed, the efficiency must be lower than the direct system. Mr. Leonard meets this by throwing the driving motor across the line when full speed is desired.

It must be remembered when considering these 10 watts for friction, hysteresis, etc., that this plan of Mr. Leonard's does not permit of gearless motors any more readily than the ordinary equipment does. Exactly the same considerations would determine whether a gearless or a geared motor should be used. Mr. Leonard states that he would use a gearless motor—why, I can't see. The efficiency in this third case would probably not exceed 10 per cent., instead of 29 per cent., as given.

One of the chief claims for this system is the reduction in power house equipment. Mr. Leonard thinks he can use 6 h. p. per car at the power house, and consequently greatly reduce the copper needed. This is based on the assumption that railway managers will be satisfied with such speeds as three miles per hour on heavy grades. This I believe to be absurd. There is the strongest demand for higher speeds, and 60 h. p. equipments are now put in, not to be safe in starting, but because 40 h. p. is actually needed to haul the heavy cars up the grades at the speed they must go to maintain a decent schedule. I dare say we have all heard railway men, *i. e.*, non-electrical ones, praise a car because it went up a heavy grade at the same speed, approximately, as on the level. But even taking Mr. Leonard's 6.3 k. w. for a car on a level, and using 90 per cent. for line, 90 for generator and 87 for engines, it would require 12 h. p. instead of 6. This takes the work on a level as the average and is under the mark.

I believe thoroughly in the desirability of a variable speed gear, provided it can be obtained without sacrificing too much; but I do not think this particular one fulfills that condition.

In his paper he gives a table intended to show the first cost of the two systems; from what I have already said, the following modifications of the table follow:

TABLE II. (AMENDED),

showing probable comparative first cost per car by present and proposed system; the latter as estimated by H. W. L. and C. T. H.

	Details of Plant.	Present System.	Proposed System.	
			By H. W. L.	By C. T. H.
1	Steam plant, generators and conductor	$2,200	$1,100	$2,200
2	Motors, two 15 h. p. equipment	1,800	1,400	1,800
3	Power converter	0	900	2,400
5	Switches, etc	200	30	30
	Total	$4,200	$3,430	$7,430

I estimate the power converter as 60 h. p. at $40, not a high figure for tramway motors, and put the power house output the same in both cases. This makes a total of $7,430 as against $4,200.

Another point which has not been brought out and which works against the idea that the cars will use the same current is the very much greater weight of this equipment. There will be say 30 h. p. on your driving motors, 30 h. p. for the generator and 30 h. p. for the line motor, making 60 h. p. additional machinery. This 60 h. p. will weigh in the neighborhood of 6,000 pounds. That with a load of 45 passengers is a heavy load.

Against the advantages claimed by Mr. Leonard I think the disadvantages are: Increased cost of total equipment per car; the adding of two additional machines, with the consequent increased cost of repairs, depreciation and maintenance; the greatly increased weight of the car, with the consequent increased power required; the very small saving over commutated field regulation, due to the low efficiency of large machines lightly loaded; and, greatest of all, sacrifice of simplicity.

The advantages are: excellent speed regulation, ability to return energy to the line, and ability to use electric braking.

Mr. C. O. MAILLOUX, in his discussion of the same subject, said:

There is one point which occurred to me as Dr. Hutchinson was speaking; it is in relation to facilities for regulation as affecting the probable success of the storage battery. If we stop to think for a moment we realize that the storage battery is certainly not deficient in regard to the means of regulation which it affords. In fact that is one of its strongest points. If it were as strong in all other points as it is in the facilities which it affords for regulation, there would be no trouble and no doubt as to its success. One of the readiest means it affords and one of the earliest ways which was thought of for regulating storage battery motors was to divide the storage batteries into a number of groups and to group the circuits in parallel at the start, and then gradually group them into different arrangements of series, multiple and so on. In that way you get a variable electromotive force, so that you attain, to a considerable extent, the very object which Mr. Leonard undertakes to obtain with his machinery, viz., a variable electromotive force of supply.

But there is another point coming in there which I think argues in favor of using two motors in a car, even though there may be, as we recognize, an economy in using only one. The use of two motors lends itself beautifully to regulation, as it enables us to start with them in series, and to couple them in parallel later, and play similar changes with the batteries, and thus we get a whole chain of regulation, so that we can get the same thing practically as if we had four or five different initial electromotive forces. The method of using batteries in parallel and motors at the same time was first tried, I think, by myself on Fourth avenue in 1887, and has been used more or less since by all having to use storage batteries. It has not come into use in connection with trolley roads until quite recently. I think that it is only this year that it has been agitated and brought into practical use. However, to-day there are very few roads that do not practice it and with considerable success.

In relation to the variable speed ratio method of regulation he said:

The cost of coal is not such a large item after all, while the amount of money involved in the depreciation is usually a very important item, which frequently exceeds that of the cost of coal. It is, therefore, a serious question whether it is worth while to think of using such methods, at least in the present state of the art of mechanics. It is possible that some new application of mechanical principles that we do not know of yet may be discovered, which will enable us to accomplish in a simple, uncomplicated way what we all dream of as an ideal, but I know of nothing of the kind now. The motor man seems to find in practice that the fewer handles and levers you give him to manipulate the better off he is.

Dr. EMERY said:

I understand that series parallel or series multiple traction is pretty well covered by patents. If my information is correct I do not see how the various applications spoken of by the last speaker can be made by engineers generally, and will be pleased to hear the statements of others more fully informed on the subject.

Mr. SPRAGUE, in his comments, said:

The series system was tried at Richmond five years ago. Twenty cars were fitted with multiple series switches used with the commutated fields. They worked perfectly so far as increased torsional effort, the slowing down of the machine, and all that, was concerned. The method was not patented. Where it failed was when on heavy grades the attempt was made to run the machines in series, and to start on a slippery track. In that case, if there was slipping on one portion of the track on account of ice or sleet, or for any other reason, one motor would begin to race and the other motor would slow down. The claims made for series multiple regulation have afforded me a good deal of amusement. As to the effectiveness there is no question, but the series multiple system, when running at full service, will make little difference in the coal burned. So we simply threw away our series multiple switches and ran our machines invariably in multiple. The action of two machines in series is easily understood. Of course, the total counter electromotive force built up is the sum of the counter electromotive forces of the two motors, and if one runs fast the other must necessarily run slow, so that sometimes we had one running one or two hundred revolutions a minute and the other standing dead still.

Dr. EMERY added:

I think that Mr. Leonard has a very strong competitor in shunt motors, which, though thoroughly understood, have not to my knowledge been heretofore applied in such a thorough way as recently by Messrs. Siemens Bros. & Co. on the new locomotives of the City & South London Electric Railway.*

Apparently these motors have been made heavy enough—in other words, iron enough put into them—so that considerable changes of speed can be made by simply varying the strength of the field without any material sacrifice in economy, and the dead resistance of a rheostat is only used for a few seconds in starting. At first sight this would appear to be a system applicable to street car motors, but on careful consideration it will be seen that there must be a sufficient section of iron in the field and armature to utilize the whole strength of the field at a reasonable point below saturation, so as to obtain the low speeds satisfactorily, and there must be a sufficient number of ampère turns on the field at the high speed to prevent sparking. It does not appear that both these conditions can be obtained without the use of more iron than is ordinarily employed with series motors of less range. Such an arrangement should not, however, be objectionable when the motors are put upon a special car to form an electric locomotive.

Prof. FRANCIS B. CROCKER, among other things, said:

On any line where you have a clear track there are usually only three conditions to consider. One is standing still, one is starting, and the other running at full speed. Now those three are, any or all of them, easier to take care of than running at very slow speed for a long time. That is the hardest thing to do for an electric locomotive or electric street car. What is true of a train that can always run at full speed when it gets started is by no means true of a street car system where perhaps you have to run at half speed, or even quarter speed, for a long period of time, if you are behind a truck or going through a crowded street, or under various conditions that will suggest themselves to any one who has ridden on a surface city railroad. The experience on the City & South London Railway would be a very poor thing to adopt as the standard of street car practice. On the other hand, the success of this railway is a very encouraging thing to the electrical engineer, who looks forward to seeing electric locomotives used on long distance service, where we have a free right of way and the ordinary condition of working is full speed.

Dr. EMERY, replying, said:

The efficiency tests of the Siemens motors referred to were necessarily made in the shop with a brake resistance, and the different speeds given merely translated into car speeds by calculation. These tests showed an efficiency of 90 to 92 per cent. for variations of speed between 12¼ and 30.6 miles per hour.

Mr. CHARLES HEWITT made these remarks:

The use of the shunt motor for street cars has not been entirely neglected in this country, and is certainly not original with Siemens & Halske. I am not sure but that the president has tried it in the early days, and although Siemens & Halske may be able to use their locomotive successfully in London on that particular road, it certainly will not be a success here, until we get a much smoother running trolley than we have at the present time. Any one noticing a trolley running here will find that at almost every hanger there is a slight sparking. This is due to the slight contact and sometimes no contact at all, due to the jolting of the trolley from the wire. I have been on cars with a voltmeter when I could count every clip by the swing of the needle. With a shunt motor every time the trolley leaves the wire the shunt field is discharged, and when it strikes the wire again you get a short circuit through the armature. This trouble is still worse when the trolley wheel jumps off, as it frequently does at switches. I believe in London they use a third rail and a top-running trolley wheel, perhaps two of them, and are sure to get a contact all the time.

Mr. SPRAGUE:

When taking into account the fact that you can return a certain amount of energy to the line, I question very seriously if the shunt method will not hold its own in time even on a great many lines of street car service.

Mr. MAILLOUX, taking up the discussion, said:

I said a little while ago that the cost of power itself was very small, and it was usually smaller than the cost of the depreciation. It seems to me that if we want to make it still smaller, if we want to reduce the cost of power pure and simple still further, that there is a much wider margin to work upon in the station itself than in the cars or motors. A number of engineers have investigated this subject, and it has been shown that, owing to the constant fluctuation of the load, and the fact that the power is constantly varying, that the engine is cutting off at full stroke and then at very short stroke, in very rapid succession, the average (mean effective) economy, so to speak, of the engine, is very poor. For that reason more than any other compound engines have not turned out the results which were expected of them, and we do not obtain from the coal used the horse power that we ought to—not by 15, 20 or 25, sometimes 40 per cent.

I believe various methods have been submitted for increasing the station efficiency. I advanced one myself some two years ago, which has not been popular because the storage battery was used as a factor in it. There is, in my opinion, a good time coming when the storage battery will have its innings, and will be used in every electric power generating station; but meanwhile there may be other ways available or possible of equalizing the load, and thereby increasing the efficiency of the plant. A method has been advanced, depending on a peculiar form of steam engine, by a concern which makes an engine that is said to give almost constant economy under very wide ranges of load. The makers claim to have been able with their engine to reduce the water consumption for given duty from 40 pounds per horse power per hour, to 26 and 30, which results, if correct, ought to receive the attention and consideration of electrical engineers.

Mr. SPRAGUE said:

We are going to have increased efficiencies in our central stations when we adopt direct connected machines.

Regarding Mr. Leonard's system, Mr. SPRAGUE said:

There is much assumed in the matter of economy, but when we consider the time limit involved in starting, I unhesitatingly assert that the amount of coal burned in the central station will be fully as great, if not greater, by this plan, than with the system of direct supply, because of the amount of energy needed for the continuous rotation of the power converter.

Mr. H. WARD LEONARD replied to his critics as follows:

The fact, in regard to the question of efficiencies, is that quite accurate tests have been made of the system by a concern so well equipped for making tests as Wm. Sellers & Co., of Philadelphia, and that the efficiencies shown by the tables in this paper have been quite well borne out. As regards the figures I have given in the tests, Dr. Hutchinson has pointed out one or two apparent errors, but I think it is due to a misunderstanding of one or two points by him. One point which he spoke of was the impossibility of having a central station equipped with only six horse power per car when in one of the most favorable cases he figures out eleven and a half horse power as required by a car. Without stopping to check that figure, I would say that I did not intend that six horse power in the central car would be enough if every car would be in operation simultaneously at its full power, but that six horse power per car would be an average figure, some of them being at rest or going slowly, and some coming down grade, under which conditions they would assist the central station.

The saving at the central station due to the size of apparatus of course is a factor which we can only theorize on, but I think that in view of Mr. Shepardson's curves it is rather evident that if we could supply a system in which the very large changes of load due to the starting of the car could be avoided, we could get along with less dynamo and engine capacity in the central station, and by the results of tests on traveling cranes and a few elevators, and by the figures of railway tests, I am convinced that the central station capacity in engines and dynamos could be cut in two. However, I wish to call attention to the fact that the cost of the street car apparatus to-day is not such an important factor as to very materially affect the cost of the entire equipment. In one installation that I am making to-day the entire cost of the street car motors is only about 5 per cent. of the cost of the complete work; and if any very great advantage, either in economy, control, or in any point might be obtained by making that 5 per cent. 10 per cent., it still would be quite an advantage. The proposed system here certainly will tend to give an almost constant load in the central station and effect a very large economy by the possibility of using engines of the highest type and operating them at the most economical cut-off.

As regards the depreciation of machinery, which I find I have made a memorandum of, there is, apparently, three times as much depreciation in three machines as in one; but when two of those machines are placed out of the influences which are the principal cause of depreciation, and when the third one is in a condition such as to have a minimum of sparking, and a minimum of heating of its field, and when the motor generator portions are also under the best conditions as regards sparking, etc., such will not be the case. The fact is, that in practice the operation of the system shows that the machinery requires almost no attention.

I call attention to the fact that in this system there would be but one lever which would accomplish all the changes of speed in either direction, and also apply the brakes, as the production of energy and the restoring of energy to the line is the braking action for the car, and under any normal use of the system no mechanical brakes of any kind would be used, and the instance cited by Mr. Sprague of something on the track which makes reversal necessary can be dealt with by this system with the greatest of ease and the utmost rapidity.

One of the best points in connection with the system, in my opinion, is the ability to restore energy to the line in coming down grade or stopping, and what follows directly from that, the stopping of the car by an electric brake which is not only an electric brake in the sense of being operated by electricity, but a brake which is an efficient means of stopping the car. It is the only brake I know of which will enable one to stop a car from its full speed down to a dead rest, and at all times during that period the application of the brake causes a positive saving on the system by the production of energy to assist in operating other devices. There are numerous modifications of this system, and, as you will notice, one good point is due to the fact that the secondary circuit has no connection with the line, which makes it possible to use any voltage desired in this circuit, and if in railway practice it became desirable to use a thousand volts for our trolley, we would still be able to use upon our commutators in the propelling motors 250 volts or 300 volts or 500 volts, or anything desired. The principal point of importance, to my mind, is the flattening of the load diagram and what it accomplishes. That means, I believe, the cutting in two of the engine and dynamo, a very great increase in the economy of steam in the steam plant, especially in view of the energy restored to the line, which also assists in cutting down the capacity required in the station. This system will soon be tried on a street car.

DISCUSSION OF THE PAPER OF PROF. SHEPARDSON AND MR. BURCH ON "ELECTRIC MOTOR TESTS."*

Dr. HUTCHINSON taking up the discussion on this subject said:

These experiments were made apparently in the shops of one of the railway companies at Minneapolis. They are evidently made with crude apparatus, and as far as I can make out from reading the paper rather carefully the conditions of the tests are not accurately specified. In many cases one cannot tell at what voltage the test was made. No attempt is made to note the temperature; that is to say, the resistance of the circuits at the time the efficiency was measured; altogether I should not regard them as of the very highest degree of accuracy. Nevertheless I think the results he gives are in substantial agreement with others.

Referring to some tests made by himself, Dr. HUTCHINSON said:

These tests were all made by an electric method. We adopted this method after trying in vain to get consistent results from Prony brake measurements; we tried various forms of the Prony brake, but were unable to get satisfactory results; impossible efficiencies were frequent. Finally we gave up all attempts to make mechanical measurements, and used the electrical method altogether. This method demands very few simultaneous readings, only two, and allows the correction for temperature to be made very easily. That is, one can reduce all efficiencies to the standard temperature, so that the efficiency curve is given for the standard temperature. From these curves the No. 6 Sprague motor has an efficiency of 83 per cent. at 20 ampères, falling to 80 per cent. at 35, and running down in the other direction to 80 per cent. at about 12 ampères. That is to say, between 10 and 35 ampères the efficiency at the armature shaft is above 80 per cent. The efficiency with gears from 35 to 15 ampères is pretty constant at about 75 per cent. This is a very much better efficiency and better results in every way than I have seen published for any motor except some which apparently were distributed at the meeting of the Street Railway Convention in Cleveland the other day. These were of the Short Company's new gearless motor. Results are there given for four gearless motors, and one, if the curve is correct, is by all means the most admirable motor I have ever seen in the way of efficiency. It reaches a maximum of about 87 per cent. at 7.5 h. p., and is practically constant at 14 h. p. The curve crosses 80 per cent. at 5 h. p. and again at 21 h. p., so the efficiency from 5 to 21 h. p. would aver-

* See THE ELECTRICAL WORLD, June 18, 1892, p. 421.
† See THE ELECTRICAL WORLD, June 18, 1892, p. 416.
* See THE ELECTRICAL WORLD, Aug. 27, 1892.
* See THE ELECTRICAL WORLD, July 9, 1892, p. 24.

age about 83 per cent. This motor then has a very high efficiency at low loads, a feature greatly to be desired. We all know that the street car motors run for nine-tenths of the time at very low loads. A motor which has high efficiency at low loads and drops down even to 60 per cent. at full load is very much better than one that goes up to 80 at full load and drops down to 50 per cent. at a quarter load.

Fig. 1 gives two rather interesting test curves of a No. 6 Sprague motor, showing how the efficiency at low loads can be raised by increasing the number of turns on the field; that is to say by working at a greater excitation at light loads than is usual. This is rather interesting and would be a very good thing if it were possible to work in that way. But unfortunately it does not take speed into account, really the ruling consideration. It is often said that the commutated field method of working is absolutely wrong, because it gives the maximum number of turns at the very worst time,

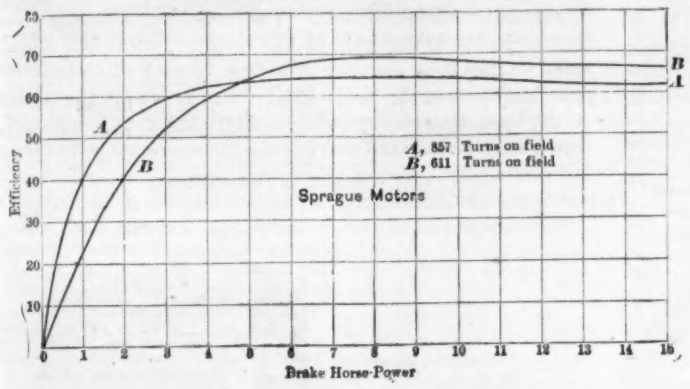


FIG. 1.

Prof. Shepardson brings out that point, and to a certain extent it is true. He makes one observation on which I think is extremely pertinent and which everybody will have something to say about sooner or later; that is that an average of 12 tests on a road showed that on a car with two motors it required 27 per cent. less current when only one is working. I dare say that most of us think that one motor is the proper thing now that motors can be so built that there is no longer danger of serious accidents. It is easy to see how the saving comes about. If from the current and torque curve of any motor one finds the current for a car under any conditions on the assumption of one motor and then on the assumption of two, the result will show greater current when using two motors. This means simply that the motors are working at lighter loads, and consequently at lower efficiency.

There is another point which Prof. Shepardson touches rather lightly. He speaks of the comparative value of the rheostat and "commutated field" methods of regulating. This matter has been argued back and forth for more than three years, but in this time no one, apparently, has thought of appealing to experiment to settle it. It seems to me that the matter can be definitely decided very simply, and to this end, that we may hear no more of the subject, I have prepared the following table showing the case of

"COMMUTATED FIELDS VS. RHEO TATS."

C.	Position.	S.	φ_1	φ_2	φ_3	$\varphi_1 - \varphi_3$
20	VII.	9.1	81%	..	81%	0%
20	IV.	6.3	69	63%	60	9
20	I.	4.4	50	44	42	8
15	VII.	10.6	83	..	83	0
15	IV.	7.3	73	64	61	12
15	I.	5.4	59	48	45	14
10	VII.	13.3	78	..	78	0
10	IV.	8.8	75	63	60	15
10	I.	7.0	66	50	48	18

Here φ_1 is the efficiency of a No. 6 Sprague motor for the various current values and corresponding speeds taken from my tests referred to above; values are given for the three switch positions: φ_2 is the electrical efficiency with rheostat for the same current and speed. This is calculated by reducing the E. M.F. of the motor in proportion to the reduction of speed. The efficiency φ_3 is then the ratio of the reduced E. M. F. to 500. This of course takes no account of hysteresis, eddy current and friction losses. Putting these all at five per cent., *i. e.*, taking 95 per cent. as the efficiency of conversion from electrical into mechanical energy, we get the column for φ_3; that is, $\varphi_3 = .95\ \varphi_2$.

It will be seen that in every case the commutated field method gives an efficiency higher even than the electrical efficiency with rheostat, and much higher than the best probable value of the actual efficiency.

There is one other point I will speak of. Prof. Short published on the 16th of April, 1892, in THE ELECTRICAL WORLD, an account of the practical operation of a gearless motor. This was either his first or second gearless motor. He shows, as a contrast, the efficiency of the double reduction motor on the armature shaft, on the intermediate and on the car axle. I am sorry those efficiency curves cannot be shown, but the net result is that the efficiency of his gearing is extremely low. He calls attention to it by saying. "You will find, on going over these curves, that the load varies considerably with the speed." "You will find that the efficiency is very low at heavy loads at slow speeds and rises to its highest at medium speeds and medium loads." Of course, in that particular case, his object was not to make a very good showing for the double reduction motor. Now, taking that curve as he gives it, I find for a load of five h. p. on the Short double reduction motor, on Prof. Short's own testimony, the efficiency of the gearing is 78 per cent. only. We found on the Sprague motor 87 per cent. At 10 h. p. his curve gives 74 per cent. as against our 92, and at 16 h. p. his gearing efficiency falls to 63 per cent. as against our 91. He cannot be right; it is absolutely out of the question that it should be so.

Mr. HEWITT:

I do not think the difference between the one and two motors is due so much to the low efficiency as it is to the difficulty of making two motors run together as the motors on this road were connected. It is a well known fact now that with two motors, connected according to Mr. Sprague's design, with a connection from one motor to the other between the fields and the armatures, it is very difficult, especially with the double reduction type, to get them to equally divide the load. This difficulty brought out the equalizing coils, which were invented, I believe, by Dr. Hutchinson. The matter has been simplified more recently on the new motors by giving each motor a distinct circuit. I have known cases where not only one motor has done no work at all, and the other has done all the work, but cases where one motor has turned into a generator and generated as high as 10 or 11 ampères, and the other done all the work. So that the difference between one motor and two motors in that case would be very apparent, and not due to the low load at which the motors were working.

Dr. CHAS. E. EMERY:

It is well in all brake experiments to criticise the apparatus very closely. I have seen it recommended to throw a rope over a pulley, fasten one end and apply a spring balance to the other. Evidently this cannot be accurate, except when the fast end of the rope is slack, and yet sufficient friction remains to show a tension on the spring on the other side. A rope passed with several turns about a pulley, and provided with a spring scale at each end, has been very strongly recommended, but the two scales must be read exactly at the same instant, if not absolutely steady. It would evidently be better, therefore, to replace one with a weight.

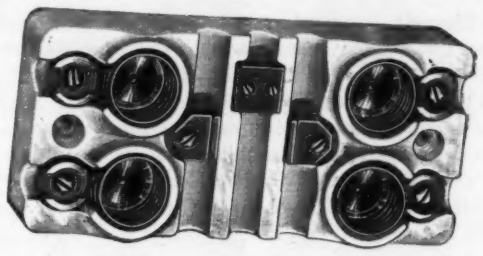
I have seen a great many clamp brakes, merely screwed up by hand, which operated quite reliably. I have found it of advantage, however, to have a spring under one of the bolts, or otherwise provide means to make the grip on the pulley elastic.

Asbestos Porcelain.

M. Garros is the inventor of a new substance somewhat resembling ordinary porcelain, but which possesses, as he claims, many advantages over that substance. The fibres of asbestos are exceedingly fine, their diameter varying between .00016 millimetres and .0003 millimetres, and consequently an exceedingly fine powder can be obtained from these. If it were possible to amalgamate these small particles without the addition of any foreign substance it is evident that a substance could be obtained which would be porous in nature but with pores so fine that they could hardly be seen under the microscope. This substance is formed by pulverizing the asbestos, a process which is rather difficult if the ordinary mortar is used, but which is comparatively easy when the proper apparatus is employed. From this powder a paste is made by mixture with water, and this paste is kneaded, diluted with water, dried and kneaded again, and then molded into the proper form. By heating the objects in a crucible to a temperature of 1,700° centigrade, a porcelain is obtained with a translucency comparable to that of ordinary porcelain, and for this reason the inventor has given the name of asbestos porcelain to the substance. If it is heated for 18 hours at a temperature of 1,200° centigrade, then porous asbestos porcelain is obtained of a light yellow, or white color if care is taken to wash the asbestos powder with sulphuric acid. Prof. d'Arsonval states that porous cups made of asbestos porcelain used in electric batteries have much less resistance than the ordinary porous cups, and it has been found that this substance is about 2.75 times a better insulator than the porcelain in common use at the time.

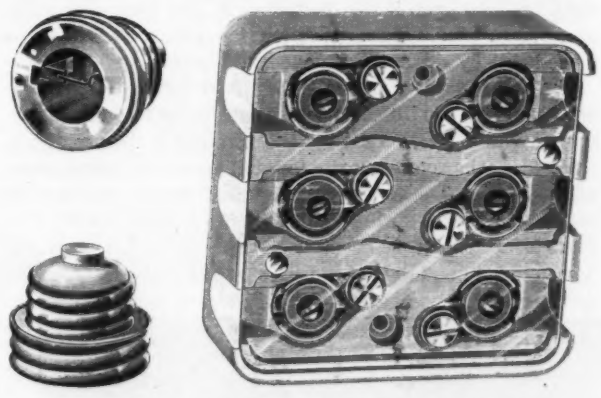
The General Electric Company's New Cut-Outs.

Improvements in the manufacture of the smaller electrical appliances keeps pace with that of the larger and more important devices. We here show some improved



GENERAL ELECTRIC COMPANY'S CUT-OUT.

pieces of wiring apparatus which the General Electric Company has just brought out. The old style porcelain plug and link cut-outs have disappeared, and the new ones, here shown, take their places as substitutes of greater efficiency. They are made of hard white, thoroughly vitrified porcelain, impervious to moisture, and a non-conductor, the metal parts possessing all the qualities necessary to render them electrically efficient. The plug cut-outs are designed to protect a circuit having a maximum current of 30 ampères at 125 volts. The fuse is carried in a small glass plug, cased and covered with brass, which is



GENERAL ELECTRIC COMPANY'S CUT-OUT.

screwed into a brass screw socket in the body of the cut-out. Should the fuse blow, the defective plug can be instantaneously replaced without tools of any kind.

In the link cut outs the fuse is a safety link with copper terminals. The binding screws and wire terminals are set well below the surface of the cut-out, and are protected by suitable sheet mica covers.

The porcelain of which these cut-outs are manufactured is itself made by the General Electric Company at its own porcelain factory at Schenectady, established in order that the quality of this important material should be of the highest possible standard of excellence.

Electrical Nomenclature.

Mr. Mordey did good service says *Industries*, by introducing the term "alternator," and in the United States they require ane qually good word to use for "direct current dynamo." "Director" seems to the point, except that it might be considered a slight upon a machine to associate it in any way with the manipulation of limited companies. We also think the plural of dynamo should be "dynamoes," as there is no reason why it should be an exception to the ordinary rules of orthography. Similarly the plural of "Henry" would be "Henries." These are all questions of convenience and the survival of the fittest. Dynamotor, a very convenient word, is rapidly coming into use. It is shorter than "direct current transformer," and runs better than "motor dynamo" or "dynamo motor." It is also made up of two languages in defiance of elementary philology, and thus agrees with many other electrical terms.

Annual Report of the West End Road, Boston.

The annual meeting of the West End Street Railway was held in Boston Nov. 10. The following directors were elected for the ensuing year: H. M. Whitney, president; G. T. W. Braman, Prentiss Cummings, E. C. Fitz, Walter Hunnewell, Samuel Little, Nathaniel Thayer, J. T. Burr, J. S. Fay, Jr., H. D. Hyde, E. D. Jordan, W. P. Mason, D. N. Richards and W. S. Swan.

The fifth annual report as presented at the meeting shows the following principal items;

Gross earnings	$6,317,205.17
Operating expenses	4,477,783.02
Net earnings	$1,839,422.15
Fixed charges—taxes, rentals and interest	509,701.54
Balance available for dividends	$1,329,720.61
Against this balance, dividend charges are:	
8 per cent. on preferred stock	$5'2,000
5 " " common " Jan. 1	357,112.50
5 " " " " July 1	454,250
	$1,323,362.50
Balance of net income carried to surplus account	$6,358.11

The earnings of the year are composed of the following:

From passenger	$6,237,646.28
" rental of track	13,422.63
" " real estate	21,509.48
" advertising and miscellaneous	44,626.78
	$6,317,205.17

The operating expenses are:

For general expenses	$363,716.49	
Maintenance of track	238,790.31	
" " buildings, cars and vehicles	273,289.15	
" " horse equipment	222,409.69	
" " electric "	256,921.87	
Transportation expenses	2,782,702.77	
Damages, snow, etc	339,952.84	
		$4,477,783.02
Net earnings		$1,839,422.15

The general balance sheet shows that of the assets permanent investments figure as follows:

Construction, $5,920,585 82; real estate, $7,342 904.07; equipment, $556,917.04; horses (3,754), $503,030; cars (1,226), $919,130; electric cars (1,028), $3,238,227 64; electric line equipment, $9'3 437.88; electric car house equipment, $99,989 57; power station equipment, $1,141,041.62; total cost of road, equipment and real estate $20,995,269 64.

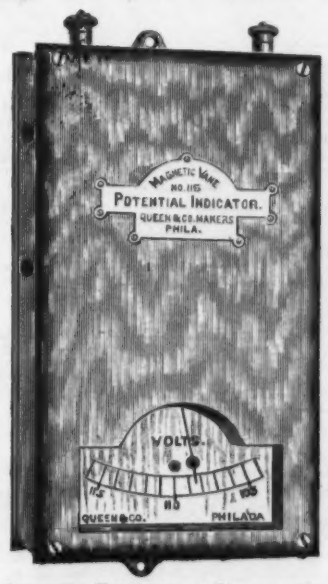
The total track operated is 263 miles, of which 116 miles have been rebuilt with heavy girder rails since the electric system was first introduced. Number of miles run are 17,498,660; passengers carried, 126,210,781; passenger receipts, $6,237,646.28. Of the total mileage run, the electric cars run 8,510,283, or 48.63 per cent., and horse cars run 8,988,377, or 51.37 per cent. Passenger receipts from electric cars were 53.39 per cent.; from horse cars 46.61.

The report shows that the earning capacity of the property has increased in direct proportion with the increase in capitalization, and kept pace with it so far as to enable the road to pay 10 per cent. dividends from net earnings. During the past four years the gross earnings have increased by over 20 per cent; operating expenses have increased about 8 per cent.; net earnings have increased nearly 60 per cent. in the same time. The proportion of operating expenses to gross earnings has dropped from 78 per cent. in 1889 to 70 per cent. in 1892. Fixed changes have increased in four years by about 24 per cent.; dividend charges increased about 115 per cent., and during this time the capital stock has been increased by $7,585,000,.

Number of passengers has increased from 104,243,150 in 1889 to 126,210,781 in 1892. The miles run in 1889 were 16,573,831, and in 1892 17,498,660. In 1890 only 526,336 were electric mileages; and in 1892 there were 8,510,293, a gain for electric mileage from 18.75 per cent. in 1890 to 48.63 per cent. in 1892.

Queen's Potential Indicator.

We illustrate herewith a new potential indicator which Queen & Co., of Philadelphia, are placing on the market.



QUEEN'S POTENTIAL INDICATOR.

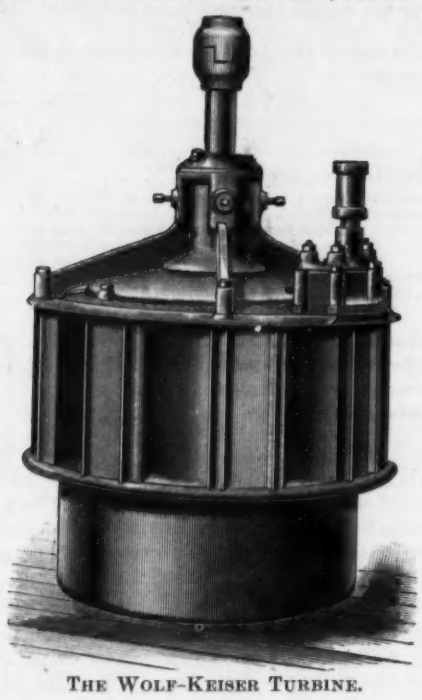
It is constructed upon the general plan of their magnetic vane voltmeter, and is mounted in a handsome mahogany case with open scale divisions, so that very close readings can be made.

No permanent magnets or other parts which change with age are used in construction, so that constancy is assured. This is a very essential feature, as most instruments require frequent calibration—an item of considerable expense as well as annoyance.

The indicators as kept in stock are adjusted for 110 volt circuits, but special ranges will be made to order. They are adapted for isolated plants and central stations.

The Wolf-Keiser Turbine Water-Wheel.

In the accompanying illustration is seen the Wolf-Keiser turbine water-wheel, which is manufactured by August Wolf & Company, Chambersburg, Pa. This wheel does not contain a network of flimsy rods, bolts and small parts which interfere with the action of the water, but is built with few moving parts and these are large strong pieces having liberal distribution of material and giving great strength and rigidity as well as durability. While simplicity of construction has been aimed at nothing has been sacrificed which is really necessary to the economical operation of the wheel. Compactness is a prominent feature of the design. All the parts are easily accessible and the turbine can be taken apart and put together without the slightest difficulty. All the moving parts are well protected from the material carried with the water and adapted to work under the worst as well as the best conditions. As a turbine is beneath the water, out of sight, and

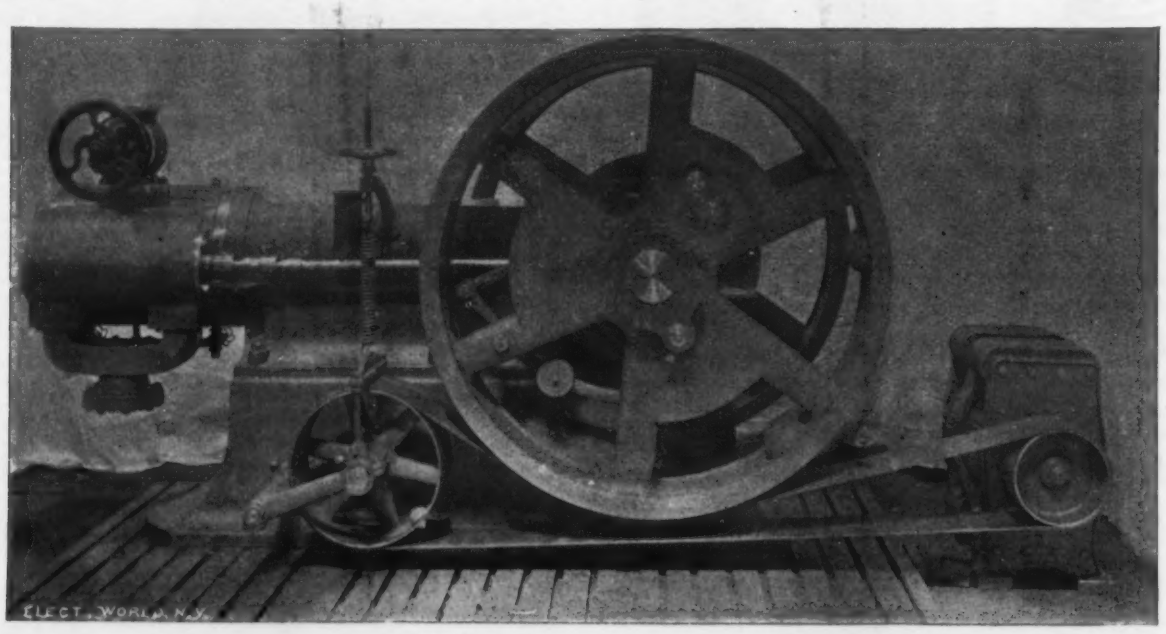


THE WOLF-KEISER TURBINE.

often not examined more than once a year, it is absolutely necessary that it should possess both great durability and simplicity, qualities which are prominent in the Wolf-Keiser wheel.

The "Ideal" Transmitter.

The "Ideal" transmitter, which is shown in the accompanying cut attached to the base of a 125 h. p. engine, is an outfit which was recently shipped by A. L. Ide & Son, Springfield, Ill., its manufacturers, to the Mason City Gas and Electric Light Co., of Mason City, Ill., for driving two incandescent generators. It will be seen that by this method of power transmission either one of the machines may be stopped or started while the engine is running at full speed by simply slackening or tightening the spring and allowing the idler pulley to drop down and disengage the driving wheel or to rise and engage it. The advantage of this device is that dynamos may be located close to the engine and a great saving made in the floor space, which is

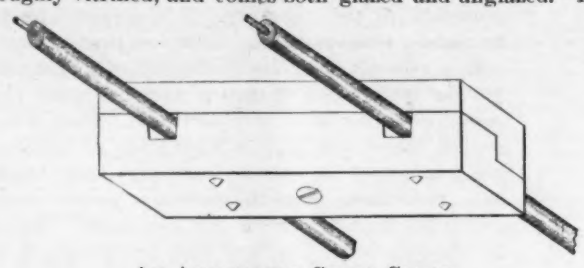


THE "IDEAL" METHOD OF TRANSMITTING POWER.

a very important point in all central stations. The yielding of the spring gives the same elastic effect that is produced by long belts and at the same time a greater belt contact to the dynamo pulley than would be possible by ordinary means. Experience has demonstrated that this device overcomes all danger of hot bearings both on the generator and the engine. On account of the increased belt contact on the dynamo pulley the belt can be run with less tension, and the tendency, moreover, is to carry the weight of the engine pulley and thus relieve the engine bearings of all s trains.

An Adjustable China Cleat.

At a recent meeting of the electrical insurance experts in New York City it was decided against the use of wooden cleats in the future. The E. G. Bernard Company, of Troy, N. Y., has designed the cleat which is herewith illustrated, to meet these requirements. This cleat has been in practical use for some time, possesses the requisite strength, and is very easy to put up. Both parts, top and bottom, are exactly alike. The cross section is so designed as to strengthen the cleat, and it requires only one screw and four small lugs to hold it securely in its position, so that perfect alignment is insured and it is very easily adjusted. The cleat is made of superior imported clay, thoroughly vitrified, and comes both glazed and unglazed. It



AN ADJUSTABLE CHINA CLEAT.

is handled by the Western Electric Company, the E. S. Greeley & Company, and Alexander, Barney & Chapin. It is claimed that already over 100,000 have been sold.

A New By-Pass Ratchet Burner.

We illustrate herewith the latest improvement in the electric gas burner, manufactured by the Electric Gas Lighting Company of Boston. The point of advantage which the manufacturer of this burner claims is that there is only one contact made in four operations of the movable arm forward and back to light and extinguish the gas. This, as will be readily understood, preserves the wipe spring from heat and smoke, thus preventing grounds at the contact points, which are always kept clean, not to mention the saving in battery power. The No. 3½ is smaller than the old style ratchet burner, but has an amply large gasway, into which is inserted a perfect working gas check, which prevents hissing. It will also be noticed that the electrode is not lifted over the fixed one through the flame, but passes under and out of the flame.

A Non-Inductive Ammeter.

All of the ammeters on the market, with perhaps a single exception, depend on magnets for their action, so that their readings are more or less influenced by the presence of masses of iron near by. In a station where there has to be so much heavy machinery this often seriously affects the readings, and even if the instruments are placed at a distance from the dynamo and engine room, two of them placed side by side will influence each other's readings.

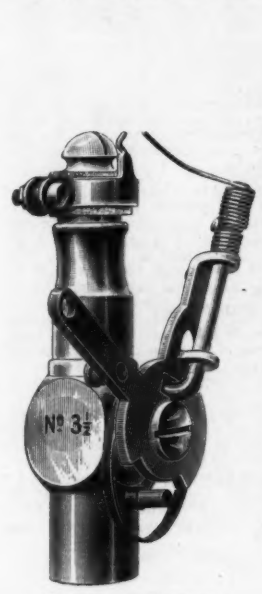
The non-inductive ammeters devised by Mr. H. H. Cutler depend on the difference in expansion of two fine wires, one of which is traversed by the current to be measured, while the other compensates for changes in the temperature of the room. The two wires are fixed at one end and are kept taut by flat springs carrying two knife edges. A yoke resting on these bearings carries a light pointer, the leverage being such that quite a small expansion of the measuring wire will move the needle across the scale. The instrument is practically deadbeat, and could be set on the polepiece of a dynamo without affecting its readings.

The cut illustrates an ammeter made with a double scale to read up to 65 ampères, the scale being much longer than in most instruments of this kind. This ammeter is equally accurate on direct or alternating circuits, and steady use for the past six months has shown it to meet the needs of central station practice. It is built in sizes ranging up to 160 ampères. It is manufactured and controlled by Mr. George Cutter, of Chicago.

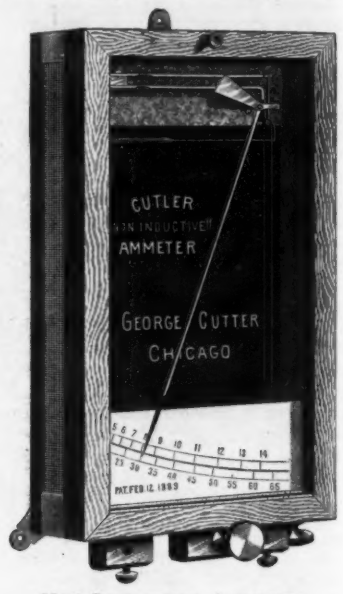
The Fitch Battery Cabinet.

The upright cabinet here illustrated is furnished with 40 cells of the Fitch Perfect battery. It is peculiarly adapted for electro-medical work. The galvanic circles, with double cell selectors, wire coil rheostat, pole changer, automatic rheotome, and the various switches to bring into circuit the milliammeter, automatic rheotome and water rheostat are mounted on a vertical base, and the Faradic coils, water rheostat and binding posts are placed on a horizontal base of polished hard rubber, all parts being handsomely nickel plated. The cells are arranged on shelves in the lower part of the cabinet, doors being provided so that they are easy of access. Heavy insulated copper wires connect the cells with the buttons within the circles on the base, the wires passing up at the back of the cabinet which may be lowered and expose the connections to view. The double cell selectors allow the operator to select any cell or cells within the circles and to use them uniformly.

They are provided with broad flange bottoms, and, when



RATCHET BURNER.



NON-INDUCTIVE AMMETER.

selecting additional cells, these slide from one button to another, always resting on one before leaving the other, so that a gradual increase of the current is insured without the possibility of a shock. The rheostat has German silver wire coils of from 5 to 5,000 ohms resistance, a total resistance of 17,000 ohms, and may be used in connection with the meter to measure the resistance of the patient, or to test the condition of the cells. The meter is a horizontal form, and has a single scale measuring from one to 250 milliampères. This is placed on a bracket in the top of the cabinet, and is easily read from a distance, a mirror being fixed at an angle behind the meter. The automatic rheotome gives graduated interruptions of the galvanic current. It

THE FITCH BATTERY CABINET.

is constructed on the principle of a clock, and is operated by a strong spring that is not likely to get out of order.

The Faradic apparatus differs materially from those in common use. This consists of two parallel primary coils, to one of which a slow vibrator is adjusted and to the other a rapid interrupter or rheotome, which is an elastic, thin metal ribbon, made fast at one end to a strong post, and at the other attached to a screw lever, whose threads are so fine that a single revolution advances the screw point one-fourth millimetre. The number of interruptions vary with the tension of the ribbon and range from 10,000 to 50,000

per minute. Three interchangeable secondary coils are furnished, being wound with different sizes and lengths of wire. The coarse coil has 75 yards No. 16 wire, the medium coil 225 yards No. 22 wire and the fine coil 660 yards of No. 32 wire. The coils are operated with four extra cells. The cabinet is made of oak, carved and beautifully finished, has beveled plate glass doors, and the inside fitted with beveled plate glass mirrors. It also contains two large drawers in which a complete set of electrodes are tastefully arranged. The cabinet is mounted on rubber tired wheels, making it easy to move over a carpet or a polished floor without marring.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

[Inquiries from our patrons for information relative to stocks and bonds of the various electric light and power companies are solicited, and will be answered in this column.]

NEW YORK, Nov. 12, 1892.

New York Financial Stock Market.—The demand for money has slackened in the East. It is now fairly plentiful. Renewals are still at 6 per cent. for all loans. The demand from the West and South continues. Exchange on New York is lower at Boston and generally higher at Western centres. The volume of trade has been fairly maintained at nearly all points despite the interruption to business by the election. Collections are quite satisfactory considering the season. Business failures during the seven days were 184 for the United States and 26 for Canada; total 210, against 291 during the corresponding week last year. There is activity in the various trade centres, with the exception of New Orleans. Trade in the latter city was paralyzed by the strike. Consumption of iron is increasing. Last month was the dullest ever known in anthracite coal, while the bituminous trade is active and increasing. Wool is active, with advancing tendency. Shoe factories will require their full working capacity until Christmas, and shipments will exceed those of last year. Bank clearings aggregate about 16 per cent. less than last week and 11 per cent. less than in the corresponding week of 1891. The bank statement shows surplus reserves of $2,678,150, a decrease of $375. For the month of October the gross earnings of 132 railroads of the country were $51,685,330, an increase of $937,665. For the year to Oct. 31 the earnings were $422,812,810, an increase of $23,822,415. The railroad freight blockade, owing to the election and bad country roads, has been partially raised. The relief, however, is only temporary, and the situation is expected to be worse than ever by Dec. 1.

The world of Wall street has spent the week since election in figuring on the result, and judging from the course of the markets during the three days is still at sea. On Wednesday there was heavy short selling by traders who had cultivated an anti-election sentiment. Their offerings were readily taken and sold back the day following at advanced prices. Yesterday weakness was manifest, and to-day the market was decidedly of the bear order. A few paramount conditions have grown out of the election. It is generally conceded that there will be a revision of the tariff.

NEW YORK ELECTRICAL STOCK MARKET.

In General.—The only stock of the list which participated in the bear campaign based on the election is General Electric. The others have shown increased values and but very little activity. The reason is not hard to find. Attention of operators has been directed almost exclusively to the industrial trusts so called), and as there was not attention enough to go around the electrical securities were neglected to their profit. The only election argument which will apply to any of the list is the possibility of a democratic investigation of the General Electric's organization on the alleged ground that it is a trust. None of the stocks have any reason to fear the effects of a revision of the tariff, while all would be benefited by less silver and more sound money. It may be possible that an unfriendly attitude of the administration toward the industrials will divert attention to railroad securities, but it is not probable that a concern possessing intrinsic worth and once installed in public favor will suffer if its organization is unassailable. North American was weak out of sympathy, setting through a narrow range and closing at 12⅝. American Telegraph and Cable sold at 86 to 87, the price of a month or more.

American District Telegraph.—Sales were made at 59 to 59½. The stock was without feature. A dividend of 50 cents per share has been declared payable Nov. 15.

Western Union.—There is any amount of speculation afloat concerning this stock, the gist of it being as to the probable price at which it will sell ex dividend. It was one of the strongest on the list during the week, closing a fraction under par, from an opening of 98⅞. It is evident that insiders are exercising a sustaining influence. The directors at a meeting on Thursday declared the much discussed scrip dividend of ten per cent., payable Dec. 3. Books close Nov. 19 and reopen Dec. 5. There were sales of bonds aggregating $35,000. Officers of the company emphatically deny the story published by the *Herald* Thursday morning to the effect that negotiations were in progress between the government and Western Union for a purchase of the latter by the former on a basis of $100,000,000 in three per cent. bonds. Last week we called attention to the fact that according to Western Union's annual report the amount of Gold and Stock Telegraph Company's stock owned had been reduced 9,579 shares and International Ocean Telegraph Company 18,829 shares. Also that no explanation was given. The company has since issued an explanation stating that they were by a clerical error omitted from the list. They were deposited as security in the Collateral Trust, and 5 per cent. bonds issued against them. The proceeds of these bonds were used to lay the two cables from New York to the Gulf of Canso, and for other actual purchases made by the company. They were, however, included in the balance sheet upon page 6, which is correct, including both the stocks named and the bonds issued against them. In the suit brought by the Postal Telegraph Company to prevent the Western Union from occupying the Phœnix Building, Chicago, recently bought by the Western Union for $1,500,000, the Western Union won. The Court held the Postal's exclusive 10-year lease simply bound the original lessor.

The *Evening Post* has a way of handling subjects without gloves. It disapproves of the Western Union scrip dividend in the following language; "It is a matter of regret that the Western Union directors should have found it necessary to follow the old and generally discredited policy of a scrip dividend. The company's new stock issue, lately authorized by the shareholders, is to be of a par value of $13,800,000. Of this amount, $8,620,000 in new stock will be allotted gratis to the present shareholders, the balance to be sold later on. Doubtless the chief apology for the scrip dividend rests on the law prohibiting the company from issuing new stock at a less price than par. A move designed to help the stock's price, which is now below 100, might therefore be argued as necessary. Beyond this there is no justification."

General Electric.—As stated previously this was the only stock to participate in the election after-clap. There have been from time to time mutterings of Congressional investigations of the company's organization, etc., but these have generally been traced to petty competitors, and have not carried weight. However, it is but natural that the sentiment should crop out at this time, and be made use of by bears. If the truth of the decline be clearly stated it would be attributed to an indifference for the moment, of bull operators. The stock will regain lost ground, and regain it rapidly when the start is once made. The lowest price was 113⅜ on Wednesday, and the closing 114½ to 115. There was a comparatively heavy demand for the debenture 5 bonds $103,000 sold at 104 to 105.

Edison Electric Illuminating.—This stock scored further advances, the maximum being 107½; $17,000 of its first five per cent. bonds sold at 108½ to 109¼. The electric wiremen's strike continues. Certain electric light companies having large contracts have decided to give up the middlemen or contractors and deal directly with the men.

Commercial Cable.—No transactions were recorded during the week. The last sales were at 170; the asking price is now 175. The next transactions will undoubtedly be at the latter figure. The upward course of this stock is an example of what can be done with a property owned almost exclusively by two or three men. It is liable to go to 200 before next spring.

WALL STREET NOTES.

The Boston Traveler says that the General Electric Company is said to be contemplating the distribution among its stockholders of $2,500,000 in treasury securities.

The Edison Electric Illuminating Company, of Boston, has notified all users of the incandescent lamp that by decision of the court Thomas A. Edison is the original inventor, and that all sale or use of any incandescent lamp in Boston without consent of this company is prohibited, etc. This is evidence plain and simple that the Edison people in general mean to reap the benefits to which they are entitled under the recent incandescent lamp decision.

War in St. Louis.—Edison Electric Company, of St. Louis, has increased its capital from $300,000 to $3,000,000. The Edison Company has heretofore kept out of St. Louis, it is understood, by agreement. A war is being waged between the Carondelet Electric Light and Power Company and the Laclede Gas Light Company. Each is determined that consumers shall not use the other's product. Merchants are being refused the privilege of using both gas and electric light. It is not at all improbable that the Edison company will step in at the right time and capture the business.

New York Subways.—The Board of Electrical Control of New York has directed the building of 10 short sections of subways on Whitehall and Front streets, on Park row, and on Chambers, Seventy-first, Seventy-second, Seventy-eighth and Seventy ninth streets, for the Edison company. The Edison company put in an application for a subway on Fifth avenue from Fifty-eighth to Sixtieth street, but a consideration thereof was refused. The board gave notice to the electric lighting companies to remove their poles and wires on the following streets; Greene, Spring, Chambers, Nassau, Bond, Franklin, Worth, Duane and Seventieth streets, and on Second avenue from Forty-second to Eighty-sixth street, where subways have been completed. The telegraph and telephone companies were ordered to remove poles and wires from Eighth avenue from Eighteenth street to Greenwich avenue.

A Wall street contemporary, which has close relations with the Western Union, reports on the authority of a prominent banker that Messrs. Joseph Pulitzer, John W. Mackay and James Gordon Bennett have purchased control of the French Atlantic Cable Company, and that the same combination has also made an arrangement for control of the lines of the new long distance telephone company. Officials of the Commercial and French Cable companies claim to know of no such negotiations or contracts. The street generally does not take any stock in the rumor.

A bit of ancient history was dug up last week. It was the old trouble between the Bankers & Merchants' Telegraph Company over the alleged cutting of Baltimore & Ohio wires by the Western Union. It was in the form of a suit before Judge Gildersleeve in the Superior Court brought by Edward J. Freedman, receiver of the Bankers & Merchants' in sequestration proceedings to recover $2,000,000 from the Western Union. The complaint charged that about May, 1885, the Western Union, with malicious intent and for the purpose of destroying the Baltimore & Ohio credit, and ruining its business, cut and detached its wires, cables and instruments and took possession of them. In consequence of this action the Bankers & Merchants', when sold under foreclosure, fetched $2,000,000 less than it would but for the trespass. The Court entered an order to dismiss the case.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, Nov. 12, 1892, and the range for the week in New York:

NEW YORK QUOTATIONS.

	Par.	Capital outstanding.	Lowest.	Highest.	Bid.	Ask'd
American District Tel....	100	3,825,000	59½	59½	57½	59½
American Tel. & Cable..	100	14,000,000	86	87	85	87½
Central & So. Am. Tel....	100	6,000,000	....	....	....	....
Commercial Cables.....	100	7,716,000	....	....	168	175
Gold Stock & Tel.....	100	5,000,000	..	....	100	103
Bonds.....	.....	500,000	....	....	100	..
Postal Tel. & Cable.....	...	10,000,000	....	....	62	64
Southern & Atlantic Tel..	25	948,775	....	....	78	84
Western Union Tel.....	100	86,199,852	98⅛	99½	99⅛	99⅝
Real estate bonds.....	1,000	1,219,000	....	....	....	..
Debenture bonds.....	1,000	4,920,000	112½	112½	....	....
Collateral Trust 5's....	1,000	8,181,000	104	105	....	....
North American.....	100	39,767,200	12¼	12⅝	13	13⅜
Brush Ill. Co. of N. Y.....	50	1,000,000	....	....	30	60
Edison El. Il. of N. Y.....	100	6,500,000	106¼	107½	107½	....
" " 1sts.....	...	.....	108¾	109¼	...	...
" " Deb's.....	...	.....	....	....	...	....
Edison El. Il. of Brooklyn.	100	750,000	...	....	85	90
" " " Chicago..	100	750,000	....	....	130	145
" " " " Boston...	....	.....	....	....	115	125
Edison El. Lt. Europe....	1,000	2,000,000	....	....	2	6
" Bonds.....	...	30,000	....	....	65	80
Edison Ore Milling Co....	...	2,000,000	....	....	15	20
East River El. Light.....	100	1,000,000	....	....	....	65
General Electric.....	1,000	50,000,000	113½	115⅝	115⅜	115⅝
Debenture 5's	....	.....	104	105	....	....
Automatic Exhibition Co. ...		2,500,000	..	....	3	5
Mt. Morris Electric.....	...	500,000	....	....	....	65
N. E. Phonograph.....	...	2,000,000	....	....	2	4
N. Y. Phonograph	...	2,000,000	....	....	2	5
N. American Phonograph ..		2,000,000	....	....	4	6
Westinghouse E. & M. Co. 1st p. 7 per cent. Cum.	50	3,717,253	....	....		....
E. & M. Co. Assg.....	50	5,038,116	....	....	....	....

BOSTON, Nov. 12, 1892.

The General Market.—As was naturally expected the stock market waited until election was over, and as the day drew near the volume of trading grew beautifully less, and prices were inclined to weaken day by day. A Democratic victory was to be considered a tip to sell trust stocks, but a Republican victory was to be a pledge that trusts were secure. When the result of the country's votes was finally decided these predictions held good, and the market opened at first with a weak and irregular feeling, but soon gained strength and surety, and the trading became active, and prices responded with an increase on nearly all the list, excepting the more prominent trust stocks, as was expected in their case. The good feeling in Europe is stimulated by the prospect of the broadening of trade relations with this country, and London will buy largely of our securities, as in fact it has already done this week; and there is no surer barometer of the markets here than the tendency to buy or sell our stocks in London. As the week closes the market is strong and active, especially on railroad stocks, and the evidence on every hand is of a bull market that has come to stay, and which will attract broad and generous buying on the part of the public. The copper stocks are very quiet, and both buying and selling orders are limited, as they are likely to remain until there is some change in the metal, either higher or lower.

The electric stocks are represented almost entirely by General Electric, which alone has been active. Immediately after election it fell off to 113⅝, on very small sales, and it looked as if it were one of the trust stocks that was going to be raided, because of a change in the Administration, but the opposite was evident on the following day, and the stock closed with the week at 115¼, and strong. The active support and large buying in New York has given the necessary strength here, and this stock will respond with each attempt of the bulls to put the market up throughout the list.

The West End Railway stock has responded to the very favorable annual report of the company, referred to in another column. It has sold more actively than at any time since the auction sales in the summer, and shows a net gain of two points, having reached 74¼. The legitimate value of this stock is plainly attested by the figures published in the annual report, which cannot fail to interest and satisfy all stockholders.

Westinghouse stock has been quite forgotten by the market, and is at present making only about one sale a day. However, it maintains its price at 38½, and does not lack good support.

The regular Fort Wayne dividend, just declared, does not seem to affect the price of the stock at all, or make any sales, but it continues to be very quiet at about 12½.

The Thomson-Houston Series D makes a sale nearly every day, and occasionally Series C is traded in, at 8 and 9 respectively.

Telephone stocks are strong, Bell leading the list at its highest figure, 208½, and all the others showing unusual strength though sales are small.

The Brookline (Mass.) Gas Light Company, which has an electric lighting business almost equal to its gas business, has recently issued 1,500 shares of stock, making the capital now $650,000. The company has paid 7 per cent. on its stock for the past two years. The property is mortgaged for $350,000. A new gas plant has recently been built on the Charles River, and the old one enlarged and altered for the electric plant, which is a very large item of the business.

Thomson European Welding.—Some information may be secured soon in regard to the condition and prospects of the Thomson European Electric Welding Company, as a banking house in this city has called a meeting of some of the stockholders to request the company to make public a detailed statement in regard to its affairs.

The Brockton (Mass.) Street Railway Company's annual statement for the year ending Sept. 30 is interesting in showing the comparisons with the previous year as a result of the change of motive power to electricity. Gross earnings were $143,506, increase over previous year $52,844; expenses $99,963, increase $14,721; net earnings $43,543, increase $18,122. This road is the property of the Industrial Improvement Company, and the above figures are a good guarantee of the conservative and profitable management in the hands of this company.

The Erie Telegraph and Telephone Company has sold its new issue of bonds to Messrs. Fuller, Harding & Co., of Boston. The issue at present will be $300,000 ten-year 6 per cent. bonds. The remainder of the total issue, $200,000, is retained for later use if funds are necessary for further metallic circuit and underground extensions, more than the surplus earnings can take care of.

The Lynn & Boston Railway Company held its annual meeting in Boston, Nov. 9, and the following named officers were elected: President Amos F. Breed, of Lynn; vice-president and clerk, E. F. Oliver, of Boston; treasurer, Charles Williams, of Boston; directors, Amos F. Breed, John S. Bartlett, Charles H. Newhall, all of Lynn; John H. Cunningham, of Chelsea; E. Francis Oliver, of Boston, E. E. Denniston and John P. Illsley, of Philadelphia; Eugene Griffin, Charles O. Billings and H. G. Nichols, of Boston; H. P. Moulton, of Salem; E. C. Foster, of Lynn. It was voted to increase the capital stock by $1,000,000, also to issue $3,000,000 of 20-year five per cent. bonds. The general offices of the company will be removed from Boston to Lynn.

BOSTON QUOTATIONS.

	Par.	Capitalization.	Highest.	Lowest.	Bid.	Ask'd.
Thomson-Houston Elec.—Series C	sh	40,000	9⅛	....	8⅛	9⅛
Thomson-Houston Elec.—Series D.....	sh	120,000	8	7⅜	7¾	8
Thomson Elec. Weld.. ...	100	1,000,000	....	....	....	....
Thomson European Elec. Weld.....	100	1,500,000	....	....	10	12
Westinghouse Elec.—New Com.....	..	6,000,000	38½	38	37½	38
Westinghouse Elec.—Pfd.	..	4,000,000	50	....	49½	50
General Electric.....	..	30,067,200	115¾	113⅜	114½	115
" " Pfd		4,136,300	118½	117⅝	117½	118¼
Fort Wayne Elec.....	25	4,000,000	12⅝	12½	12¼	12½
Fort Wayne Elec.—Ser. A.	sh	80,000	....	....	....	.. .
Detroit Elec.....	20	750,000	.. ..	....	....	....
West End St. Ry. Co.—Com	50	7,150,000	74½	72⅛	74⅛	74¾
West End St. Ry. Co.—Pfd	50	6,400,000	87½	87¼	87¾	87⅞
American Bell Tel	100	15,000,000	208½	207½	208	208¼
Erie Tel. & Tel. Co.....	..	4,800,000	46	45½	....	46
Mexican Tel. Co.....	10	1,280,000	....	....	1.	1.10
New Eng. Tel. & Tel. Co..	..	10,304,600	60	...	60	61
Tropical Tel. Co.....	10	400,000	....	....	....	....

CHICAGO QUOTATIONS.

Following are the quotations of telephone and electric stock furnished THE ELECTRICAL WORLD by C. V. Banta, Jr., 167 Dearborn street:

Telephone Stocks:	Bid.	Ask'd.
Chicago.....	214	....
Central Union	....	58½

Electrical Stocks:	Bid.	Ask'd.
Chicago Arc Light & Power Co.....	102	103
Chicago Edison Co....	168	..

NEW INCORPORATIONS.

The Oconomowoc Electric Lighting Company, of Oconomowoc, Wis., capital stock $30,000, has been organized to erect and maintain an electric light plant. G. L. Wilsey, W. Parks and J. L. Wilsey are the promotors.

Browne Telephone and Telegraph Company, of Chicago, has been incorporated with $5,000,000. The object is to manufacture and sell the Browne telephone, recently patented. It will be distinctively known as the long-distance telephone.

The Hyde Park Railway Company, of Scranton, Pa., capital stock $50,000, has been formed to construct and operate an

electric railway. Ilsley Noyes, P. S. Page and Horace E. Hand, all Scranton, are the organizers.

The Creston Gas and Electric Company, of Creston, Ia., capital stock $100,000, has been formed to acquire, control and operate gas, etc., for illuminating purposes. C. D. Jones, S. B. Hovey, and C. E. Ransier, Creston, Ia., are the promoters.

The Colorado Electric Light and Power Company, of Rico, Colo., capital stock $50,000, has been formed to furnish electricity for light, heat and power to that town. The promoters are N. N. Freeman, L. Habermann and W. W. Parshall.

The Denver Mills, Land and Improvement Company, of Denver, Colo., capital stock $100,000, has been formed to supply light, heat and power, etc. C. W. Moras, B. B. Jones, Haverhill, Mass., and Jas. H. Platt, of Denver, Colo., are the promoters.

The General Electric Company of Yucatan, of New York, capital stock $1,000,000, has been formed to furnish electric light and power in Yucatan, Mexico. Jos. Abbot, Hamilton R. Suier and Solomon Mandure, all of New York City, are the incorporators.

The Phœnix Tramway Company, of Phœnix, Ariz., and Denver, Colo., capital stock $200,000, has been formed to build an electric or other railway in Phœnix, Ariz. Frederick Robinson, Denver, Colo.; John S. Macbeth and Henry B. Robinson are the incorporators.

The Steel Motor Company, of Cleveland, O., capital stock $200,000, has been formed to manufacture and deal in electrical supplies and street railroad supplies, etc. Albert L. Johnson, Samuel Harris, H. J. Davies, C. E. Grover and L. A. Russell are the incorporators.

The Berkley Springs Water-Works and Improvement Company, of Berkley Springs, W. Va., capital stock $50,000, has been formed to erect electric light plants, etc. Eugene Van Rensselaer, D. Pratt Wright, Lafayette Bingham and A. M. Mendenhall are the promoters.

The Peru Electric Manufacturing Company, of Peru, Ind., capital stock $100,000, has been formed to manufacture, buy and sell electrical supplies, specialties and appliances and other articles. James O. Cole, C. H. Brownell, Rawley H. Bouslog and Milton Shirk are the promoters.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World, 167-176 Times Building, New York, Nov. 14, 1892.

Mr. Bernard Amend, an electrician at Schenectady, has returned to his duties after an illness of some weeks.

Charles E. Grogan has been appointed the New York City representative of the New Jersey Bronze and Lamp Company.

The Wiremens' strike is practically over. All the men with a few exceptions have returned to work and the strike is acknowledged to be a virtual failure.

Mr. George W. LaRue has severed his connection with the Crocker-Wheeler Electric Company, of which he was formerly general agent, and will, we understand, be located in Chicago hereafter.

Truex & Vail, 136 Liberty street, New York, have received through The Electrical World communications from St. Petersburg, Russia, and Berlin, Germany, that will probably lead to extensive trade for them.

Retrospective.—It was very amusing to note the faces of a number of well known members of the electrical fraternity upon the receipt of the election returns at the Electric Club last Tuesday evening. "Why did Mr. Corry laugh?" is the question.

The Ball Electric Light Company, of 404 West Twenty-Seventh Street, this city, reports increased sales in all parts of the country of its new automatic arc dynamo. A visit to the factory shows that the company is manufacturing some unusually large machines, a fair evidence of increasing prosperity.

Messrs. W. H. Fleming & Co., New York agents of the Harrisburg Engine Company, are extremely busy, as is usual, installing their engines throughout New York State and the East. This company is to receive considerable help in its New England territory by opening a New England office in Boston within a few days.

Prof. William Main, of the Union Electric Company, New York City, will give a lecture before the Department of Electricity of the Brooklyn Institute of Arts and Sciences on Friday, Nov. 18, upon "The Application of Storage Batteries as a Motive Power on Electric Railways." The lecture will be fully illustrated by apparatus and lantern slides.

One of the results of the recent strike in this city has been the establishment by some of the wiremen of The Co-operative Electrical Construction Company, which intends to do a general electrical engineering and contracting business, wiring for isolated plants, electric railway installation and the like. The office is at 12 East Fifteenth street, New York.

The McCreary Electric Specialty Company, of 136 Liberty street, New York, has just shipped its third order of specialties to Copenhagen, Denmark, and a large order to Verey, Switzerland. The McCleary company will soon put one or two new specialties on the market that will no doubt prove very valuable additions to the novelties now manufactured by them.

The First Annual Ball of the Electrical Union, No. 5,468, A. F. of L., will be held Monday evening, Nov. 21, at Webster Hall, this city. An electrical display will be made, showing among other things the name of the organization in huge electric letters made up of incandescent lamps. Some of the electrical firms of the city have volunteered to make his display free of charge. Music will be furnished by Professor F. S. McAuliffe.

Mr. John Carroll, Treasurer of the Eugene F. Phillips Electrical Works of Montreal, Canada, was one of the many visitors to New York this last week. This time he did not come alone, but was accompanied by Mrs. Carroll formerly Miss Ryan, of Newport, R. I. The wedding took place on Nov. 7 at the home of the bride and was a very brilliant affair. The happy couple received the congratulations of hosts of friends who wished them all happiness.

Mr. H. Lufkin, for many years a well known general agent of the C. & C. Electric Motor Company, has joined the forces of the Crocker-Wheeler Electric Company, and with Professor Crocker, Dr. Wheeler and Mr. Jeffrey will form an able staff which the company may well be proud of. The Crocker-Wheeler company is as busy as ever, and it will be absolutely necessary soon for them to secure additional factory room, as the quarters now occupied by them necessitate their working overtime most of the year.

The Franklin Company, since the recent decision on storage batteries, has been hard at work perfecting a new style of cell which does not infringe in any way upon the Brush patents. This cell is very compact, the grids being unusually well made and so arranged that a very large surface is secured in a very small space. The whole cell can be very quickly put together, and the weight is exceedingly small; the discharge, however, is something surprising. In a short time it will be tested on the new road in Washington.

Electric Launches Promise to Be Popular.—Mr. John Jacob Astor's new electric launch, the Corcyra, attracted considerable attention upon its first appearance on the Hudson River last week. Mr. Astor has shown considerable interest in the development of electricity, and is one of the first to take advantage of its practical application to the propulsion of pleasure craft. This boat is 37 feet over all and 31 feet 6 inches on the water line, with a beam of 6 feet 2 inches, and a draught of from 18 to 20 inches. The storage batteries which drive the motor are placed under the seats on either side. The launch can make a continuous run of from 60 to 70 miles, and has a maximum speed of about 11 miles per hour. It is designed on very graceful lines, and has proved to be a success in every particular. L. H. H.

PHILADELPHIA NOTES.

Philadelphia, Nov. 12, 1892.

James Schleicher, of the Otto Gas Engine Works, Philadelphia, has gone west on a business trip.

John L. Gill, Jr., of the Gill Water Tube Boiler Company, of Philadelphia, has returned from a western trip.

H. T. Paiste, of Philadelphia, is working hard on a new electrical specialty which he will shortly place upon the market.

Mr. Campbell, of the Campbell & Zell Water Tube Boiler Company, has taken a trip to Florida on business combined with pleasure.

Harry S. Smith & Company, Limited, electrical contractors, is the firm name of a new concern located at 607 Chestnut street, Philadelphia, where it occupies very fine quarters on the second floor. This company will carry a general line of electrical supplies, Eddy dynamos and generators, Safety insulated wire, Packard high grade incandescent lamp, electric motors, etc. Mr. Smith reports the general outlook for business very good. We wish him success.

Proceedings of the Electrical Section of the Franklin Institute.—At the meeting of the Franklin Institute held at Philadelphia Oct. 25, president Edwin J. Houston was in the chair and 34 members and visitors were present. After the transaction of some minor matters of business the first sentence of Article IV. of the by-laws was amended so as to read "The annual dues of active, corresponding and associate members shall be $2, payable annually in advance on the first of January of each year." The committee on admission reported 10 elections to membership since the last meeting. Mr. Elmer G. Willyoung read a paper on "A New Ballistic Galvanometer," and exhibited the instrument. A paper on "The Measurement of Energy in the Three-Phase System" was read by Paul A. Winand. A communication was also read from Elmer G. Willyoung inviting the section to visit the electrical laboratory of Queen & Company at Ardmore, Pa., and a committee was appointed by the chair to make the necessary arrangements. N. D. W.

PITTSBURGH NOTES.

Pittsburgh, Nov. 12, 1892.

The Suburban Rapid Transit Electric Street Railway has run its first car over the line. Strong opposition to this road has been manifested but all obstacles have at last been overcome.

The Pennsylvania Railroad Company has recently completed the installation of an electric lighting plant for the purpose of illuminating the track between Pittsburgh and East Liberty, a distance of five miles.

A local broker has threatened all the street car companies in this city that he will stop them from issuing passes on their lines. He asserts that he has looked up the law on this subject and he finds that the practice of issuing passes is illegal. He asserts that he is actuated to this proceeding by the fact that the street cars are overrun by dead-heads in the two cities, Pittsburgh and Allegheny.

The Allegheny County Light Company has added a new 250-h.p. Westinghouse multipolar generator to its plant. The company, as is seen by its name, makes a specialty of supplying current for lighting purposes, but owing to the great demand for electric power in small manufacturing places in this city the company has been repeatedly urged to supply power and has now yielded to the demand.

The Westinghouse Electric and Manufacturing Company has opened its new machine shop in Allegheny City. Large increase in the business of the company demanded an extension of the works, and the old air-brake works at Allegheny City were secured and the equipment of them pushed vigorously. Here all the World's Fair apparatus will be manufactured, and all heavy work, such as large generators up to 1,000 h. p., and dynamos up to 10,000 16-c. p. light capacity. The shops have been equipped with special tools—many of which will be run by electric motors—electric cranes and every facility for handling the work. About 500 men will be employed at first.

A Large Isolated Plant.—The Westinghouse Electric and Manufacturing Company has just finished an isolated incandescent light plant in this city, which is one of the most complete plants of its kind in the country. This plant is situated in the Ferguson Building, which is an eight-story granite structure erected for offices. The plant consists of two 60-k. w. multipolar incandescent machines of the Westinghouse make, and they can carry about 1,000 lights. The wiring throughout the building is done in first-class style. The switchboard is of marble, and all the instruments, which are also of the Westinghouse manufacture, are mounted on marble bases, and instead of the usual wooden boxes they are enclosed in glass and marble. All fuses will be replaced by automatic circuit breakers.

NEW ENGLAND NOTES.

Branch Office of The Electrical World, Room 28, Hathaway Building, 620 Atlantic Ave., Boston, Mass., Nov. 12, 1892.

Mr. George Cutter, of Chicago, is visiting the Hub.

The Leominster Electric Light and Power Company, of Leominster, Mass., has opened an office at 620 Atlantic avenue, Boston, with T. T. Robinson as treasurer.

The Bradford Self-Closing Telegraph Key Company has been organized at Clinton, Mass., with $500,000 capital stock. The president is C. W. Bradford, and the treasurer, H. W. Dodge.

Mr. Thos. H. Bibber has been appointed General Manager of the American Magnetic Electric Company, and we may look for considerable activity in the business of that company, for Mr. Bibber is a worker.

Mr. H. H. Brooks, who has been traveling in the Northwest, will extend his trip through to San Francisco before returning home. Mr. Brooks is identified with the interests of the American Circular Loom Company, of Boston.

Mr. McKee, President Harrison's son-in-law, since he entered the electrical field, has developed remarkable organizing and financial qualities, and business men who have been brought in contact with him predict that he will win almost as great success in the business world as Mr. Harrison has in the political.

The Pettingell-Andrews Company has purchased the entire stock of the Eastern Electric Supply Company. It has enlarged the railway department of its business, and Mr. Buckminster is in charge. The Pettingell-Andrews Company is about to introduce a new magnet wire, which is claimed to be the most perfectly insulated wire on the market.

The Pratt & Whitney Machine Works at Hartford are hereafter to be owned by an English syndicate. Negotiations looking to the purchase have been practically completed, and the plant will be in the control of the Englishmen in a short time. The price paid is said to be $2,500,000, and $1,000,000 of preferred stock and $1,000,000 of bonds are to be issued. The only thing to be settled now relates to the retention of the present managers.

The Thomson-Houston Carbon Company is rebuilding its factory at Fremont, O., which was destroyed by fire last February. The company had intended moving to another city, but the citizens of Fremont offered it a bonus of $35,000 to rebuild its plant on the old site. The offer has been accepted and work is progressing. The building will be of brick and iron with a slate roof, the dimensions being 336 × 70. The engine and boilers for the factory have a capacity of 300 h. p. They also intend adding a machine shop power for which will be supplied by a 150-h. p. engine. The retorts for the carbons are already finished and work is rapidly being pushed on the baking ovens. By the first of the year it is expected that the plant will be ready for operation, when a force of from 300 to 400 hands will be employed, and the output of carbons will average about 3,000,000 a month. W. R. W.

WESTERN NOTES.

Branch Office of The Electrical World, 465 The Rookery, Chicago, Nov. 12, 1892.

Mr. John W. Calkins died at his residence, 354 La Salle street, Chicago, on Monday, Nov. 7.

Mr. C. C. McLain, of the Covington (Ind.) Water and Light Company, was in Chicago this week purchasing supplies.

Mr. C. H. Rockwell, General Manager of the Buckeye Electric Company, of Cleveland, O., was a Chicago visitor this week.

L. E. Meyers, the special agent of the Detroit Electrical Works in Chicago, has added a new telephone to his office bearing the number 3,519 Main.

Among the World's Fair visitors last week were manager Van Winkle of Hansen, Van Winkle & Co., and Mr. D. T. Williams, secretary of the Lunkenheimer Brass Manufacturing Company, Cincinnati.

Mr. M. J. Sullivan, editor of the *Street Railway Gazette*, has been confined to his room by serious illness during the past two weeks, but is improving, and will be able to again greet his many friends in about 10 days.

The Electric Appliance Company, 242 Madison street, Chicago, has secured the agency for the Whitney direct reading voltmeters and ammeters, and is carrying a complete line of these standard instruments in stock.

Mr. Charles E. Gregory is already at work on a second edition of his valuable pocket combined telephone directory and memorandum book, the demand for which far exceeded the supply as soon as its remarkable convenience was appreciated.

Mr. George Cutter has brought out a push-button switch for use on incandescent circuits that will probably prove a most excellent "seller," a slight touch only being required to turn on or off the current. For desk use or wherever single drop lights are used this device has been so arranged that only a slight pull on the cord is required to "cut in," while a second pull cuts the lamp out of circuit.

Election Returns.—On last Tuesday evening the Iroquois Club was favored by Mr. Mosely with a long distance equipment and a direct wire to New York, and it was apparent to all how much superior the telephone service was to that furnished by the Western Union Telegraph Company, some of the returns being received over the telephone nearly 30 minutes in advance of the telegrams bringing the same information.

Mr. W. J. Cooke, the well-known Chicago representative of the Buckeye Electric Company, has met with the most gratifying success in introducing the new Buckeye lamp to the Western trade, having secured orders for several thousand more lamps than the company has been able to ship promptly. But the new increase in the factory equipment will enable Mr. Cooke to guarantee prompt shipment of every order intrusted to him.

Mr. Charles E. Gregory, 313 Canal street, Chicago, Ill., has furnished the Western office of The Electrical World with a complete electrical telephone directory showing the telephone numbers of every one connected with the electrical and allied interests in Chicago. This directory is bound in with a handsome morocco covered memorandum book, that will prove unusually serviceable to the fraternity, all of whom will appreciate the convenience.

The Street Railway Gazette gave an informal dinner at the Great Northern Hotel, Chicago, Oct. 27th, to Mr. Frank R. Ford, the newly appointed Chicago Agent for the Short Electric Company. Among those present were Mr. William Hazelton, third acting manager of the Short Electric Company; Mr. M. J. Sullivan, managing editor, and Mr. Lucius E. Marple, associate editor of the *Street Railway Gazette*, and Mr. Fred. De Land. Following the dinner the party adjourned to one of the prominent theatres and passed a most enjoyable evening.

The Hon. George B. Shaw, formerly general manager of the National Electric Manufacturing Company, of Eau Claire, Wis., was elected to a seat in the House of Representatives on Tuesday. Few men have won as many friends as Mr. Shaw during his short political career, and as a member of Congress there is little doubt but that he will exert a strong influence for the promotion of electrical industries, should unfavorable legislation be attempted. The Hon. Allan C. Durborow, Jr., was re-elected to the House of Representatives from Chicago.

The Electric Appliance Company, 242 Madison street, Chicago, is finding ready sale for its Elkhart transformer, for which it claims the highest possible efficiency, with close regulation under light load, or with full load, and furnishes with each transformer a two years' guarantee in which it agrees to replace any transformer free of charge to purchaser, should it fail to operate in a satisfactory manner during that period. It is worthy of

note that a number of the large and well-known alternating lighting plants in the country are using the Elkhart transformer exclusively.

The Columbian Manufacturing and Supply Company, which is the Chicago representative of the Standard Thermometer Company, of Peabody, Mass., has equipped its factory with a complete line of improved machinery and is now engaged in light manufacturing and devoting especial attention to the manufacture of electrical instruments and electrical specialties to order. The officers of the company are: D. F. Coykendall, president; Thomas Hull, vice president; John T. Todd, secretary and treasurer; C. R. Baum, superintendent.

Mr. B. B. James, A. M., has organized a class for instruction in Electrical Mechanics, to meet once a week in room 58 Athenæum Building. The following subjects will be considered: Batteries, signal and alarm devices, constant current machines and regulation, constant potential machines and regulation, motors, alternators and transformers, simple and multiphase alternating motors, three wire systems and modification, underwriters' rules, testing, calculating wires and estimating plants, railway and mining machinery, telephones and telegraphy, miscellaneous.

Mr. B. E. Davis, the general representative of Pass & Seymour, of Syracuse, N. Y., has secured some good orders for Pass & Seymour's special china tubing that has proved so serviceable in electrical construction work wherever tubing is required, more especially where glass would be found too brittle and rubber would deteriorate, as the china tubing is both tough and thoroughly vitrified. Where circuits are carried over awnings, or around iron girders, a curved china tubing is supplied that is spoken of highly for use around steam pipes, where the highest grade of insulation is required. Mr. Davis has also secured orders for their special china cleat and for their china motor cut out, as well as for their other specialties.

A Little 'Lectric Pill.—Under this caption the Electrical Supply Company is sending out a little pillbox containing a streamer reading as follows: "Sunbeam lamps. A certain restorative for loss of financial strength, uneasy rest, low dividends, weariness of soul, and that general flabbergasted feeling that saps the life of the central station after a season of short-lived, inefficient smoky lamps. Sunbeam incandescent lamps hold their rated candle power longer and more economically than any other made. Experience proves that they give the most light for every dollar invested in current. Prescription: Get a barrel of Sunbeams, and administer the doses wherever and whenever your system seems in need of a stimulant. You can't take too many. No possible chance for a fatal overdose."

An Automatic Telephone Exchange.—The Strowger Automatic Telephone Exchange of Chicago gave a practical demonstration of its system last week at La Porte, Ind., sixty miles distant from Chicago, where a complete equipment for eighty subscribers has been installed and twenty-four subscribers already connected in circuit. A special train of Wagner coaches left the Lake Shore depot at 11 A. M. arriving at La Porte at 12:30, and returned to Chicago at 5:30 P. M. Luncheon was served en route by Kinsley. Among the number of distinguished guests forming the party was Prof. John P. Barrett, chief of the Department of Electricity of the World's Fair, and representatives of the local, the electrical and the industrial press, including THE ELECTRICAL WORLD and the *Scientific American*. The party was met at the depot by a committee of citizens and, escorted by the local band, proceeded to the Central Exchange, where Mayor Scott of La Porte welcomed the guests and tendered them the freedom of the city. Then followed an explanation and practical demonstration of the utility and simplicity of this system, which was fully described and illustrated in THE ELECTRICAL WORLD of Aug. 13, 1892. The exhibition was very successful and excited great interest among those who witnessed it.

F. DE L.

News of the Week.

THE ELECTRIC LIGHT.

Casey, Ill., is to have electric lights.

Ilwaco, Wash., is to be lighted by electricity.

Dundee, Ill.—The electric lights were turned on Nov. 1.

Akron, O., will probably have another electric light plant.

Carroll, Ia., is taking steps to secure an electric light plant.

Maron, Ill., will have its electric light system in operation in a few days.

Fullerton, Neb., will illuminate its streets by electricity before the close of the year.

Monmouth, Ill., is to substitute arc for incandescent lights in its street lighting system.

Greenfield, Ind., is now lighted by electricity after a darkness of 16 months, since the passage of the law prohibiting the use of gas in flambeaux.

Tucson, Ariz.—An electric light company has been organized and application made for a charter, so that it is probable that the city will soon be lighted by electricity.

The Rushville (Ill.) Electric Light Company, L. B. Lawler, superintendent, is in the market for a boiler 16 ft. long and 60 in. in diameter, with a full plain front.

The Vandalia Electric Light Plant, E. G. Burklin, proprietor, is about to install a plant of a capacity of 50 2,000-c. p. arc lamps and 800 incandescent lights, and is in the market for that number of lamps.

The Edison Sault Electric Company, Sault Ste. Marie, Mich., is setting two 48-inch "Success" turbines and a large consignment of machinery which has just been received from the shops of S. Morgan Smith, York, Pa.

The Schuyler Electric Search Light, used by the Hartford *Courant* to signal election news to the central portion of the State, proved a great success. The light was seen from near Middletown, Springfield, Mass., and Clinton, L. I.

St. Paul, Minn.—A. J. Leitch has purchased the electric light plant at White Bear Lake from the Northwest General Electric Company, and contemplates the erection of a new building with five times the capacity of the present plant.

The Springfield Alumnæ of Mt. Holyoke College (Mass.) at a recent meeting appointed a committee to secure a fund for lighting the college by electricity; $2,000 has already been secured, and it is stated that $2,500 more will soon be obtained.

Salt Lake City, Utah.—The electric light plant, gas works and street railway, have been purchased by E. H. Rollins & Sons, of Denver, Colo., and negotiations are pending with the Rapid Transit Company for the transfer of that plant to the same bands.

The Lexington (Va.) Light and Power Company has placed an order with the Westinghouse company for incandescent and arc dynamos and a large order for supplies with the Southern Electric Company, of Baltimore. Robert Poole. Son & Co., of Baltimore will furnish the water wheel and power connections. It is expected that the plant will be in operation by Jan. 1, 1893.

Quick Work.—The Denison (Tex.) Light and Power Company recently replaced an old Van Depoele machine by an 80-light Wood arc dynamo, and made a record for quick work that is not often equaled. Within 10 days the company put up a two mile circuit, purchased, received and tested a dynamo from a point 1,200 miles distant, placed the lamps on the circuit and tested them, and delivered the light in a perfectly satisfactory manner to the consumers.

Kansas City.—The ordinances for the construction of city electric light works have been signed by the mayor. The Fort Wayne Electric Company agrees to operate the works for $13,980 per year, and the interest on the bonds for the construction of the works is $8,935, so the total expense is slightly less than that which the city at present has to bear, while about one-third more light will be secured. There will be 9 towers, each of 10,000 c. p., besides 2,000 c. p. arc lamps suspended from the ordinary mast-arms.

THE ELECTRIC RAILWAY.

The Fort Clark Line, Peoria, Ill., is to be equipped with electrical car heaters.

Delaware, O., now has an electrical street car line system in successful operation. The franchise for this road was granted Nov. 2, 1891. The Brill cars are used, equipped with 20-h. p. and 25-h. p. Westinghouse single reduction motors. Steam power is rented from the Electric Light and Power Company.

President Richardson, of the Atlantic Avenue Railroad Company, of Brooklyn, says that the Atlantic avenue trolley cars will be running by the last of December. The delay in starting the cars is said to be caused by the strikes in the iron works. One hundred new cars for this line are being built by the St. Louis Car Company. Four have already been sent to Brooklyn as samples, and have met with approval. Each car will be equipped with two 30-h. p. Westinghouse motors.

MISCELLANEOUS NOTES.

Beatrice, Neb.—The electric power plant was totally destroyed by fire, at a loss of about $10,000, leaving the city in darkness and without street cars.

Mr. C. E. Smith has resigned his position as Electrician of the Department of Construction and Repairs at the Norfolk Navy Yard to connect himself with the Citizens' Light, Heat and Power Company, of Portsmouth, Va., as superintendent.

Delivery of Mail by Electricity.—In anticipation of a large volume of mail at the World's Fair at Chicago, the details of an elevated road have been submitted to the post office department by the United States Rapid Transit Company, of Chicago. The plan is to erect this system between the Exposition grounds and the Chicago post office and to transmit the mail at a very high rate of speed.

The Collapse of a Big Strike.—The great strike which has been on for some time at New Orleans, La., has at last been declared off and resulted in the defeat of the Amalgamated Council, which controlled all the trades unions of the city. About 15,000 men were out, including those employed in various electrical industries, so that for a week New Orleans has been without lights, cars or carriages, and business has been seriously interfered with. Governor Foster took possession of the city, ordered the militia under arms, and announced his intention of placing the gas and electric light works in operation, and of running the street cars. The Amalgamated Council then withdrew its demand that none but union men should be employed, and the strikers returned to work.

Mr. Campbell Scott, of Louisville, Ky., who has until recently been acting as manufacturers' agent and electrical engineer in that city, has made another step forward in organizing the Southern Engineering Company, with headquarters at No. 236 238 Fifth street, Louisville. His associates in the new enterprise are Messrs. Harry I. Wood and J. Hoadley Cochran, the former having been engaged with Mr. Scott for the past year and the latter having until recently been the president of the Ainslee-Cochran Company, Louisville, manufacturers of engines, ice machines and general steam apparatus and machinery. Mr. Scott will look after the electrical work, Mr. Cochran the steam work and Mr. Wood the office affairs of the new concern. The Southern Engineering Company will give its entire attention to southern territory and will act as engineers and contractors for steam plants and apparatus, electric light, railway and power plants and all classes of electrical and steam work. It is representing and selling in its territory National alternating apparatus, Detroit Electrical Works direct current apparatus, Standard arc apparatus, the Buckeye lamp, Paranite and Roebling wire and Interior Conduit tubing.

The Nineteenth Century Goddess "Electra."—In a moment of apparent delight at the prospects of applied electricity, a writer in the New York *Sun* gives expression to the following: "A new goddess is born. She is called 'Electra.' She is the goddess of all work. She is swifter than Mercury and brighter than the star of the morning. On her brow is a blaze of jewels; she carries a flame tipped wand. Her garments are of woven rays of light, garlanded with flowers, red, blue, green. She comes to unbind burdens, to succor women and horses. There is no service so exalted that she cannot attain to it, no service so lowly she will not perform it. She will light the kitchen fire and cook the breakfast. She will wash the dishes and scrub the floor. She will curl and brush the hair. She will sweep the room and run the sewing machine. She will run errands and draw the cart. She will pull and fill the teeth, be the physician and put you to sleep. She will play on the piano, or on the washtub, as she is desired. She will amuse the children or entertain the company. She will tend door or convene the elements. Minerva, Venus, Juno were idle, quarrelsome hussies compared with the goddess of the Nineteenth Century—the Goddess Electra."

A Successful Electric Launch.—Mr. L. H. Thullen, the electrician of the Leetonia Electric Light and Power Company, of Leetonia, O., in a recent communication sends us a description of an electric launch designed by him which has been in very successful operation during the past six months at a pleasure resort a short distance from that place. The launch is 21 feet in length, 5 feet 6 inches in beam, and will seat 16 people comfortably. It is driven by a 1 h. p. Perret motor which receives its power from thirteen 300-ampère hour cells manufactured by the Bradbury-Stone Storage Battery Company, of Lowell, Mass. The launch under full load runs at a speed of about seven miles per hour, and has during one day made as many as 15 trips of three miles each with a very heavy load of 30 people without recharging the batteries. The batteries are generally run for about 11 hours before recharging, and during the past summer have given excellent satisfaction, requiring practically no attention at all. Both the charging of the batteries and the whole care of the boat is in the hands of a man who never saw a motor or a battery before. The dynamo which charges the batteries is run by a turbine and does not require the presence of an attendant during the time of charging.

Industrial and Trade Notes.

The Hall Electric Signals are being installed an the Memphis line between Kansas City and Rosedale, Kan.

The Akron Electric Company, of Akron, O., has secured the contract for a $13,000 electric plant in the new Lexington Hotel at Chicago.

The Donaldson-Macrea Electric Company, of Baltimore, Md., is making a specialty of storage batteries, and reports business very gratifying.

The Bliss Engineering Company, of Washington, D. C., has been awarded the contracts for several plants recently, and reports business exceedingly brisk.

The King Bridge Company, of Cleveland, O., is building the iron roof for the new power house of the Cincinnati, Newport & Covington Railway Company at Newport, Ky.

S. Morgan Smith, York, Pa., manufacturer of the well known "Success" turbines, has recently made a shipment of several iron-cased horizontal wheels to Japan for use in electric light stations.

Widmer & Spranley, 78 Custom House street, New Orleans, La., have recently sold to Max Frankle one 5-h. p. motor, to P. Theilen one 5-h. p. motor, and to Charles Carroll one 5-h. p. motor.

The Electrical Supply Company is sending out an ingenious little whirligig informing the public that it would never have "That tired feeling" if it used the Shield brand moisture proof wire.

The Reis Electric Specialty Company, of Baltimore, Md., has established a construction department in connection with its business and, though having been started but a short time, Mr. Reis reports very gratifying results.

J. J. Jones & Sons, 39 Vesey street, New York City, report large sale of their contact protected electric bells during the month of October. The Western agency for these bells has been taken by the Central Electric Company, of Chicago.

The Mather Electric Company, 97 Nassau street, New York City, reports the sale during the past week of one 150 and one 35-light dynamo to Messrs. Holme & Co., Newark, N. J., and one 10-h. p. motor to Mr. C. H. Jones, 114 Fulton street, New York City.

The White & Middleton Gas Engine Company, of Baltimore, Md., reports business exceedingly good so much so, that the company is unable to supply the demand promptly. The inventors of this new gas engine are Messrs. Charles White and A. R. Middleton.

The Empire Slate Flint Glass Works, F. Thills' Sons & Co., 578-586 Kent avenue, Brooklyn, N. Y., report large orders for their pump bulbs, battery jars and other glassware specialties. This company manufactures flint and colored glassware of all descriptions.

O. D. Pierce & Co., Philadelphia, Pa., electrical contractors, have been very busy this fall, wiring and installing plants. The company has just completed the wiring and lighting of the large building on the corner of Broad and Cherry streets, which will be occupied by a winter circus company.

The Central Electric Company reports the heaviest sales for Okonite wire in the month of October that it has ever experienced. The Washington carbons are finding a ready sale, several of the largest companies throughout the country having contracted with the Central Electric Company for all the carbons they use.

Smith's Indispensable Sliding Calipers are finding favor among machinists, tool-makers, draughtsmen, pattern-makers and others who have to do accurate measuring. These calipers combine a square, straight edge, scale, depth gauges, inside and outside calipers, etc., all in one. They are made entirely of steel, carefully finished throughout and the wearing parts hardened.

The B. F. Sturtevant Company, Boston, Mass., has printed a second edition of 10,000 copies of its 200 page General Catalogue No. 61, which describes the uses of the Sturtevant blowers, exhausters, engines, forges and heating and ventilating apparatus, and the company desires to place a copy in the office of every superintendent, purchasing agent, engineer or manufacturer using such machinery.

Mr. E. A. Gay, Rochester, N. Y., recently of the firm of Putnam, Gay & Co., has now engaged in the electrical specialty and supply business under the firm name of E. A. Gay & Co., with an office in the new Beckley Building, South Clinton street. He has secured the general agency for the Carpenter electric heating and cooking apparatus and also deals in wire, cord, lamps and other electric lighting supplies.

The Lobdell Car Wheel Company, of Wilmington, Del., has placed the contract for its new machine shop with the Berlin Iron Bridge Company, of East Berlin, Conn. The building will be 67 feet in width, divided into a central portion 25 feet in width, with a wing on each side 21 feet in width. The central portion is controlled by a traveling crane. The building will be 151 feet long, the entire frame work being of iron, with side walls of brick.

The American Silk Manufacturing Company, manufacturers of wipers used for the same purpose as cotton waste, is constantly making new customers, the most recent of which are the United Electric Light and Power Company, of New York City; the Springfield Electric Light and Power Company, of Springfield, Ill.; Fort Wayne Electric Light and Power Company, of Fort Wayne, Ind. The two former companies have adoptod these wipers exclusively.

The Electric Appliance Company has just closed arrangements with the Whitney Electrical Instrument Company, of Boston, to handle its celebrated line of testing instruments in the West. The Whitney instrument has already established a reputation for accuracy and ability to stand rough usage, and it is also particularly neat in appearance. The Electric Appliance Company will carry a large and complete stock and push them extensively in the West.

Paul T. Kenny, Bennett Building, New York City, agent of the Mather Electric Company, reports the following contracts during the past month: For the new Herald Building, four 450-ampère dynamos, one 40-h. p. motor, two 20-h. p. motors, and all the necessary apparatus for their equipment; this is an important contract, and was secured in the face of strong opposition; J. B. Hoecker, 584 Fulton street, Brooklyn, 1-h. p. motor; T. F. Larkin, 286 Fulton street, Brooklyn, three h. p. motors; the Jennings Lace Works, one 5-h. p. motor; Charles H. Jones & Co., 114 Fulton street, New York City, one 10-h. p. motor.

The B. F. Sturtevant Company, Boston and Chicago, has received orders recently for supplying its system of heating to the large foundries being constructed by the National Malleable Castings Company, Chicago, and the Carnegie Steel Company, Bessemer, Pa. Each of these plants will require a blower over 20 feet in height, and the heaters will contain over three miles of one inch steam pipe. Both these foundries will also be supplied with the Sturtevant cupola blowers, to be driven by direct connected Sturtevant electric motors, and will be the largest of this type of machine that have been installed in this country.

The Viaduct Manufacturing Company, of Baltimore, Md., has removed from 14 South Charles street to the Telephone building, corner of St. Paul and Bank lane. The ground floor of this

building is used as a salesroom and for storage purposes. The company has also fitted up a nice suit of rooms on the third floor for its executive offices. This location is very desirable, and one which affords the company much better facilities to display its electrical goods. This company has engaged 608 square feet of space in the balcony of the World's Fair Electrical Building, Chicago, where it will have on exhibition a large line of its well known electrical specialties.

The Ball & Wood Company, of New York, were gratified to receive a few days ago a letter from Mr. Fred. Sargent, mechanical and electrical engineer of the World's Columbian Exposition at Chicago, saying that the Ball & Wood engine furnished the entire lighting for the Manufacturers and Liberal Arts Building during the recent dedicatory ceremonies, and that the service was very satisfactory. As the lighting of the building had to be done in a hurry a temporary power house was quickly erected and the engines were taken directly from the cars and immediately set up and started. Mr. Sargent says that the results obtained speak well for the perfect condition in which engines are turned out at the Ball & Wood shops.

The Southern Engineering Company, of Louisville, Ky., reports as having at its first week's business secured the following contracts: Water Supply Company, of Georgetown, Ky., reconstruction of present Thomson-Houston alternating plant, the installation of a 125-h. p. tubular boiler, a 35-light Wood arc apparatus, 25 lamps, street construction, belting, reconstruction of steam plant, etc.; Marion County Distillery Company, Louisville, 15-h. p. Houston, Stanwood & Gamble engine, complete electric light plant, comprising 150-light National direct current dynamo and a handsome lot of fixtures; Kenton Club House, Louisville, complete outfit of handsome combination fixtures; Falls City Manufacturing Company, Louisville, 5-h. p. Card electric motor; C. C. Mengel, Jr., & Bro. Company, 30-light Wood dynamo, etc.; the electric light, wiring, electric gas lighting and bell work in the following residences—Mrs. J. B. Baskin, W. G. Bridges, P. B. Scott, G. W. Griffiths, besides considerable other wiring and construction work.

Business Notices.

Transformers rewound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

U. S. PATENTS ISSUED NOV. 8, 1892.

21,981 (Design). Design for an Electric Motor Frame; Barron D. Southard, Chicago, Ill. Application filed June 20, 1892. This invention consists of a motor frame the side portions of which have substantially parallel adjacent surfaces swelling upon their opposite sides into convex portions. Between the parallel surfaces is a cylindrical connection. From these parallel surfaces the two sides curve toward each other and decrease in thickness, terminating at the top in concave surfaces facing each other, and at the bottom in slightly diverging portions, spreading slightly at the bottom.

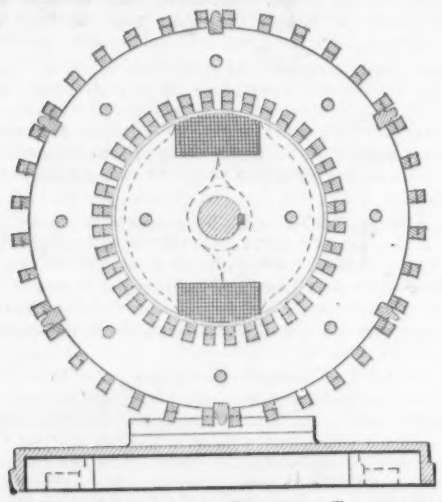
485,615. Manufacture of Carbon Filaments; Thomas A. Edison, Llewellyn Park, N. J. Application filed Dec. 15, 1886. A method of making incandescent conductors for electric lamps, consisting in suspending filaments of carbonizable material in a closed chamber, exposing the chamber to carbonizing heat, and breaking off the filaments below the point of suspension.

485,616. Manufacture of Carbon Filaments; Thomas A. Edison, Llewellyn Park, N. J. Application filed Dec. 15, 1886. A process of making filaments for incandescent electric lamps, consisting in heating a suitable hydrocarbon until the volatile constituents are driven off, then forming filaments from the dry carbon residuum directly by heat and pressure—that is, without the addition of any binding material—and then carbonizing the filaments thus formed.

485,617. Incandescent Lamp Filament; Thomas A. Edison, Llewellyn Park, N. J. Application filed July 27, 1888. The method of making carbon filaments, consisting in forming the filament from plastic asphaltic hydrocarbon residues, then dehydrogenizing the filament to the point where it can be carbonized without melting, and then carbonizing the filament.

485,618. Apparatus for and Process of Refining Copper by Electricity; Franklin Farrel, Ansonia, Conn. Application filed April 26, 1892. The combination, with an electrical refining tank and supports of sufficient width to serve as a support for an impure plate and for a refined plate, of a vertically arranged series of impure plates wholly submerged in the electrolytic bath, and supported therein by the supports, the construction being such that the top, bottom and side edges of the plates are in contact with the bath, and electrical connections for electrically connecting the plates at the opposite ends of the tank with the poles of a current generator, whereby the current may be passed through the plates in series.

485,619. Rheostatic Controller for Electric Motors; Jonathan P. B. Fiske, Lynn, Mass. Application filed Feb. 5, 1892. The combination, with a shunt-wound motor, of the rheostatic controller having line contacts, short circuiting contacts connected together, brushes connected, respectively, to opposite motor terminals and bearing alternately on the line contacts and short-circuiting contacts and breaking contact with the former before making with the latter, and a rheostat having regulating connections to the armature.



No. 485,609.—Continuous-Current Transformer.

485,620. Electric Motor Controller; Jonathan P. B. Fiske, Lynn, Mass. Application filed Feb. 5, 1892. The combination, with an electric motor, of a circuit for its armature connections, a coil in shunt to the armature circuit for maintaining the switch in its operative position, and a coil in connection with the armature circuit acting to release the switch upon the existence of abnormal current therein.

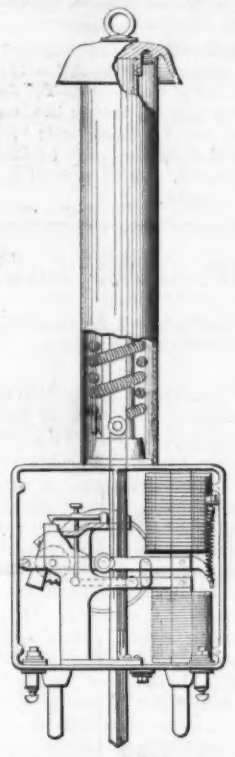
485,643. Switchboard for Electric Light Circuits; John J. Moore and Catherine M. Henry, administratrix of Dorwin A. Henry, deceased, New York. Application filed April 9, 1890. An electric light switchboard having a metallic frame supporting at a distance apart two plates of slate or similar non combustible insulating material, and a set of wires or bars on each plate, crossing each other at an angle and provided with connection sockets at the crossing points.

485,645. Electric Clock; James D. McAnlis and Harvey E. Fleming, Beaver Falls, Pa. Application filed June 7, 1892. In an electric clock mechanism, a swinging weight arm connected with, and moving the mechanism, and provided with a strike arm and a strike lug, a circuit closing pin mounted in, and insulated from, the metallic frame of the mechanism, a spring actuated circuit closing arm mounted adjacent to this pin and provided with a notched shoulder and strike arm engaged by the lug, a spring actuated securing pawl engaging the shoulder, a pawl wire connected with this securing pawl and engaged by the strike arm of the weight arm to disengage the pawl from the shoulder, an electromagnet in circuit with the circuit closing pin, a lifting arm controlled by the magnet and arranged under the weight arm.

485,647. System of Lighting Railway Cars and Platforms; Danton H. Nichols, Boston, and Charles Leonard Cotton and Charles Albert Cotton, Dedham, Mass. Application filed Sept. 7, 1891. The system of lighting railway cars by two electric lamps at opposite ends, but on the same side of a car, a circuit for the lamps, two switches in the circuit, one near one end and the other near the other end of the car, and reflectors, one for each lamp, each constructed and arranged to distribute the light along the steps and side of the car and outwardly and downwardly.

485,658. Electric Transmission of Power; Edwin Wilbur Rice, Lynn, Mass. Application filed Sept. 18, 1891. The combination, with alternating and direct current supply mains, of an alternating motor and a direct current motor or dynamo respectively connected to such mains and mechanically connected together, a switch in the connection for the direct current supply mains, and a connection independent of the switch from the direct current motor or dynamo to the field magnet of the alternating motor.

485,659. Electric Transmission of Power; Edwin Wilbur Rice, Lynn, Mass. Application filed Sept. 18, 1891. An alternating current motor having connections from its armature to a source of alternating current supply, in combination with a direct current machine having connections, including switching devices, to a source of direct current supply and connections, including other switching devices, to the field magnet of the alternating motor, the machines being mechanically connected together.



No. 485,744.—Electric Arc Lamp.

485,668. Electric Railway Switch; Charles A. Stone and Edwin S. Webster, Boston, Mass. Application filed Oct. 30, 1890. In combination with the trolley arm of an electrically propelled vehicle, a supplemental trolley and means for pressing the supplemental trolley with yielding pressure against its trolley wire for the supplemental trolley, and a track switch electrically controlled and connected with the supplemental trolley wire.

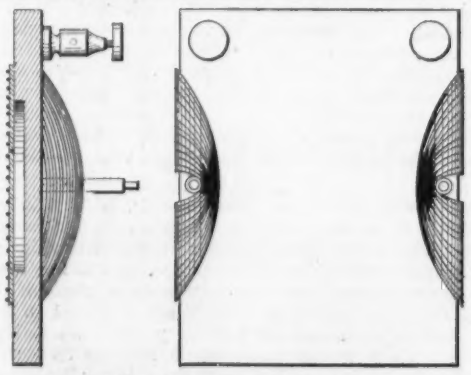
485,669. Continuous-Current Transformer; Elihu Thomson, Swampscott, Mass. Application filed Aug. 28, 1891. An electromagnetic inducting machine comprising a fixed field magnet and a rotating armature having interior radial projections clearing the field magnet by only a small air space and having two sets of coils superimposed in the spaces between the projections. (See illustration.)

485,682. Incandescent Electric Lamp; Augustus C. Carey, Lake Pleasant, Mass. Application filed Jan. 15, 1892. In an incandescent electric lamp, the combination, with the leading-in wires, and the filament or carbon, of couplings therefor constricted between their ends and connected with the leading-in wires by crimping the wires and couplings together transversely.

485,728. Electric Railway System; Adoniram J. Wilson, Port Chester, N. Y. Application filed Feb. 29, 1892. In a block signaling apparatus, a normally closed signaling circuit including in the main part thereof a normally closed circuit-breaker, constructed to be opened by the action of the train on the section of track that is guarded by the signal and also including a normally closed branch or shunt of low resistance around the signaling magnet, and in the branch or shunt a normally closed circuit breaker, constructed to be opened by the action of the train on the section of track preceding the guarded section.

485,739. Thermostat and Alarm; Gustav Fischer, Chemnitz, Germany. Application filed July 20, 1892. The combination, with a source of electric energy and an alarm, of a spring connected to and in circuit therewith, coated with hard gelatine to hold the spring in position to maintain the circuit open.

485,744. Electric Arc Lamp; George Kirkegaard, Brooklyn, N. Y. Application filed May 13, 1892. The combination of the lower carbon support of an arc lamp, a detachable and adjustable ring connected thereto, the ring provided with a gutter or support for a globe, and an annular spring-plate located above the gutter and adapted to bear against the inside of the globe with a yielding pressure to hold it in place. (See illustration.)



No. 485,876.—Telephone.

485,754. Electric Belt; Emory Nathaniel Tefft, Iola, Kan. Application filed July 30, 1892. In an electric belt, the combination, with the end electrodes, of separate cells, each comprising a central battery plate projected at one end, absorbent packing surrounding both sides of the battery plate, and an outer double layer battery plate looped entirely around the central plate and the surrounding packing and having perforations in its looped end, non-corrosive retaining bands encircling the outer plate of each cell and passing between the end perforations thereof, and connecting loops passing through the perforations in the looped ends of the outer plates on each side of the bands and connected to the projected ends of the central plates.

485,826. Voltmeter; Eugene Carichoff, Richmond, Ky. Application filed May 12, 1890. In a voltmeter, two high-resistance wires stretched side by side and connected at intervals by cross pieces, the wires having a twist imparted to them, in combination with a suitable pointer connected transversely with the wires, and a scale.

485,841. Method of Magnetically Separating Ores; Thomas A. Edison, Llewellyn Park, N. Y. Application filed July 20, 1892. The process of treating ores containing magnetic oxide of iron and magnetic pyrites, consisting in first crushing the ore, then passing it through a magnetic separator of sufficient strength to separate the entire magnetic material from the non-magnetic gangue, and then passing the concentrated ore through a magnetic separator of such strength that, due to the difference in specific magnetic capacity of the oxide of iron and the pyrites, the oxide of iron particles will be separated from the pyrite particles.

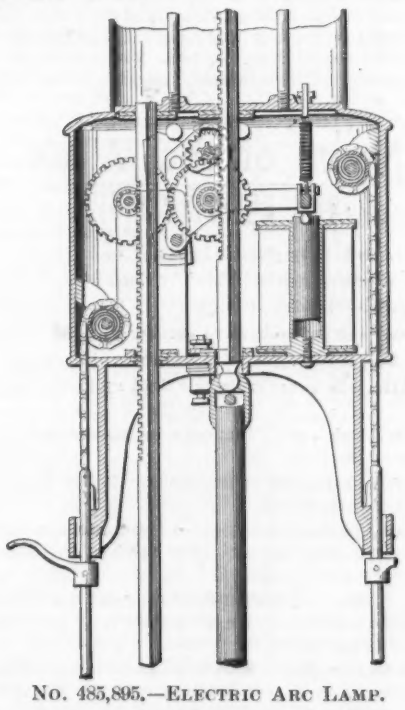
485,842. Method of Magnetic Ore Separation; Thomas A. Edison, Llewellyn Park, N. J. Application filed July 20, 1892. The process of separating nickeliferous from non-nickeliferous pyrrhotite where both occur in the same ore, consisting in subjecting the crushed material to a magnetic action of such strength that, due to the difference in magnetic capacity between nickeliferous and non-nickeliferous pyrrhotite, the non-nickeliferous pyrrhotite will be acted upon magnetically, while the nickeliferous pyrrhotite will not thus be acted upon.

485,859. Telephony; William Bruening, East Orange, N. J. Application filed Aug. 1, 1891. In a reversible apparatus for transmitting sound vibrations, a confined fluid, in combination with three or more dashers held movably in contact therewith, and two or more parallel diaphragms.

485,876. Telephone; James W. McDonough, New York. Application filed July 21, 1884. In a telephone, a vibratory plate or body having electric conductors or portions of electric conductors arranged substantially parallel to one another over substantially the whole surface of the plate or body, and substantially parallel with the latter, and arranged to form a diaphragm in themselves, and having the capacity to vibrate as a diaphragm, and communicate their motion to substantially every part of the plate or body. (See illustration.)

485,895. Electric Arc Lamp; James R. Steers; New York. Application filed May 28, 1892. In an arc lamp consisting of a single bent rod attached at its middle to the globe, and at its ends to chains or cords passing around spring actuated drums located in the body of the lamp, in combination with locking and releasing devices. (See illustration.)

485,919. Manufacture of Mandrels for Electrolytic Deposit of Tubes; Francis Edward Elmore, Leeds, England. Application dated Aug. 12 1891. The process of manufacturing mandrels for electrolytic deposit of tubes thereon, which consists in coating the mandrels by revolving the same in contact with easily fusible material while the material is in contact with a heated polishing surface.



No. 485,895.—Electric Arc Lamp.

486,029. Electric Forge; George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass. Application filed Dec. 22, 1891. In an electric forge, the combination of two horizontal conductive arms connected with opposite electric poles, two brackets hinged to the arms provided with two sets of eyes, arms adjustable in one set of the eyes, electrodes attached to the inner ends of the arms, and guide arms supported in the other set of eyes and connected with the electrodes.

486,047. Railway Signal Apparatus and System; Jacob W. Lattig, Easton, Pa. Application filed Aug. 18, 1892. The combination with two toothed slide bars forming part of the signal operating mechanism, a clamp lever, pivoted latch-lever locking and releasing the clamp lever, and the electromagnet and its armature lever for controlling the detent.

486,051. Telegraph Sounder; James Maret, Mount Vernon, Ky., and Wm. Loveland De Graff, Homer, Mich. Application filed Aug. 4, 1891. In a telegraph sounder, the combination of an electromagnet, poles connected by a bar of non-magnetic material, connected and having their ends separated, an armature rod having an armature arranged above the ends of the poles, adjustable contact points, and an adjusting spring for the armature.

486,054. Water-Indicator for Boilers; Wm. Henry Rodgers, Bay Side, N. Y. Application filed May 21, 1892. A water-level indicator for boilers or a device adapted for use as a thermostat, consisting of a shell, a vessel contained within the shell and provided with an extension projecting beyond the shell, the vessel and its extension being adapted to contain a contractible and expansible substance, a diaphragm constituting a portion of the receptacle, a lever fulcrumed upon the diaphragm, a contact lever actuated by the diaphragm lever and pivoted to the casing near one end, and an alarm mechanism in battery connection with the shell, the circuit being opened and closed by the contact levers.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.